SIMULATED ATC

By Iven L. Ellis

Note: This document is not for real world use, only virtual flight simulation.

1st Edition

PREFACE

Simulated online Air Traffic Control (ATC) service is one of the final frontiers for the flight simulation community. Nearing the age of 50 I have been involved with flight simulation since its inception and have enjoyed it immensely through the years but ATC simulation, although tried in many forms, has yet to be seen at its full potential in my humble opinion. Many of those that have artificially simulated ATC through programs such as Radar Contact by JDT LLC http://www.jdtllc.com/ have brought us a much improved ATC system to flight simulator but primarily in the single player environment.

The multiplayer environment is severely limited to only a few dedicated ATC services on the Internet. Although they have good software tools and provide very realistic environments for simulating flight they do not always provide a complete flight experience from departure to destination due to "holes" in the service from the lack of controllers and their ultra realistic environment tends to be very intimidating to those less skilled. The holes in their service are caused by the methodology applied to providing ATC service, one controller, and one position in a specific area. This problem also limits the scope of activities which in turn limits the pilot's choice to fly where they wish and still receive ATC service.

But what if I told you there were ways to eliminate all of these problems and no matter how few controllers there were available, even with only two, that a complete and realistic flight experience could be enjoyed by any pilot, anywhere on the virtual planet. Is that possible? The answer is yes! This manual covers every aspect of online ATC play using only a few software resources available today coupled with some innovative methods to provide the best flight experience possible suited for all ages and skills.

You'll learn how to conduct VFR or IFR operations at controlled or uncontrolled airports and much more. I'll cover everything you need to know as a virtual pilot or controller. If you're a pilot that wants to try your hand at flying with ATC service this manual will show you how to "get connected", how to sound polished and professional, and even how to fly and conduct the more sophisticated instrument landing procedures from a virtual perspective. If you're the person who wants to be an Air Traffic Controller then this manual will describe the methods to use the software described herein for use by any ATC service and how to sound as polished and professional as the pilot.

This manual will draw a baseline of realism by using the U.S. FAR/AIM (Federal Aviation Regulation and Aeronautical Information Manual) to establish the ATC environment. Please realize that online ATC organizations may have specific guidelines for their individual operations so this manual is best used as an overview of related operations for online play. This manual is designed to help all that read it reach a common level of play where experienced and amateur alike can meet together and enjoy online ATC activities.

I started writing various tutorials during a two year administration of a virtual airline ATC operation. My goal was to assist interested members to become more familiar with real-life aspects of aviation and better apply this knowledge to online activities. Blending my experiences as an online ATC manager, real-life private pilot, USAF aircrew member, and knowledge of communications I will endeavor herein to bring a unique insight into virtual online ATC operations. I do not claim to be the expert of aviation, my goal is simply to paint the big picture and provide a few details of how the flight simulator community, when connected together in an online multiplayer environment, can enjoy the last growing frontier for flight simulation, online "Live" ATC.

In the flight simulator community there are varied opinions as to what constitutes a great ATC service and who provides the best. The answer to that question lies in your personal preferences. I believe everyone should try several ATC services before making a final decision. Depending on your level of skill there are many attributes of an ATC service that may make it your preferred service. This manual is not an argument as to which is better. The primary goal is to impart knowledge of real-life aviation operations, translate that into a practical version for simulated ATC activities that anyone can enjoy, and provide training that will help everyone reach a common level of play using available free/pay software.

There are bright spots looming on the horizon as some developers work to bring us updated tools and enhance everyone's ability for better play. I'll discuss some ideas for software improvements based on lessons learned but we must ask for it, as you know how the saying goes "the squeaky wheel is the one that gets the oil", I just hope it happens before they have to pry my cold hands from my throttle and joystick <grin>!

Regards,
Iven L. Ellis

HOW TO READ THIS MANUAL

When you sit down to read this manual make sure your comfortable and can read it without being disturbed (serious!). This is not your typical novel. It is more a technical document and you need to be able to concentrate on what you're reading. If you find yourself becoming tired while reading that is a sign that the information is not registering in your mind. Take a break and stretch, go get something to drink (not to strong a drink <grin>), maybe a cup of coffee. When the blood is pumping again come back to read some more. This will allow you to absorb the information better.

The manual is intended to be read from the beginning in a chronological order. In other words it is built to flow from one subject to another smoothly building on the things previously discussed. Even though each individual topic was written as a stand alone section, these sections are arranged in an order to promote a gradual learning curve. Later when you have read the entire manual you can easily reference the individual topics to refresh your memory on a particular topic.

The reader must remember to keep the proper perspective about what is being presented in this manual. I'm trying to translate into simple terms what is done in a realistic complex world of aviation. Many things discussed in the manual start from the big picture of real-world aviation, then are brought to a level more compatible with a broad audience, young and old, with or without real-life experience in aviation, and finally providing the skills and methods so all can meet and play on a similar level. Also various topics may be discussed from the pilot's perspective or they may be discussed from the controller's perspective. So look for these differences when reading the material herein so you can apply it to your preference.

The table of contents provided is actually the outline that was used to write the manual. Each chapter, topic, and subtopic has the page number in parenthesis to the right of it.

Chapter 1 discusses how the virtual world we play in is formed. There aren't a lot of software platforms available to form online ATC environments and some are proprietary and not free for public use. In this chapter I discuss software that is available free to the flight simulator community except for FS Navigator which is payware. I also discuss some other software that can enhance the online ATC game play. Finally I discuss based on the current features of the software presented what would make exciting enhancements for future improvements based on the methodology described in this manual.

Chapter 2 discusses the methods to use the software described in chapter 1 and make them work efficiently considering the pros and cons of the software. Over the years managing an online ATC service, many innovative methods have been learned and brought about by individuals using this software to overcome the technical drawbacks inherent in the software. Also mentioned are other management techniques that allow an ATC service to operate with even only a few dedicated controllers and still provide their pilots with complete and satisfying ATC experiences.

Chapter 3 discusses the common elements of VFR and IFR flight. These are elements that a pilot (or controller) need to understand to successfully complete a flight under VFR or IFR flight conditions. Basic knowledge requirements of airspace, airports, flight plans, flight preparation, airways, navigation, emergency procedures, and safety of flight are included.

Chapter 4 discusses the specifics for conducting VFR flights. It describes what VFR flight is and involves. Discussions include complete flight scenarios between controlled and uncontrolled airports. Also discussed is VFR flight following and how it can work in a multiplayer activity.

Chapter 5 discusses the specifics for conducting IFR flights. It describes what IFR flight is and involves. Common elements specific to IFR flying are described along with detailed flight scenarios between controlled and uncontrolled airports. Lessons are provided for you to learn how to conduct various instrument approaches. You learn how to interact with controllers in an online environment.

Discussions include special topics unique to IFR flight such as standard instrument departures and standard terminal arrival routes. You are provided the information required to understand the charts and maps required to fly instrument flights.

Chapter 6 provides common terminology and phraseology for communications. Complete communications scenarios are provided for VFR or IFR flights from and to controlled and uncontrolled airports. These scenarios will provide the reader a basic foundation to feel confident and sound like a pro when joining online activities.

Chapter 7 discusses pilot and controller roles and responsibilities as related to online activities. During various flight procedures pilots and controllers will learn to understand better what is expected from each other. This understanding will translate into smoother online operations.

By the time you finish this manual you should be able to join an ATC activity armed with the basic knowledge of all segments of flight operations lending to a great simulated flight experience. You'll have a complete picture of how the virtual world we play in is formed and how it allows each of us to enjoy the fantastic adventure of flight.

LEGAL LINGO

It's simple actually! I released this manual freely to the public for private use. That means you can download a copy for yourself to use and pass it along freely to anyone. The catch is don't sell this manual to anyone for your own profit. If you do then it means I can, fair and square, try and collect any and all money you make from the sell of the manual. It is my work not yours! I choose to freely give it to the flight simulation community. So use it to your hearts content just don't try to sell it!

If you're interested in doing anything with this manual other than for your private use then contact me so we can discuss it. I always enjoy a good conversation about flight simulation or online ATC simulation. If you have suggestions or comments those are equally appreciated.

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DEDICATION

This manual is dedicated to my best friend Alan Rear (a.k.a. Badger) who spent years, months, weeks, days, and many hours online with me, talking about everything, anything and simulated ATC. We never saw each other as he lived in England and I in the U.S.A.; amazing how the Internet makes our world so small and brings us together. I will miss his soft spoken English accent and friendship so very much.

Oh Controller who sits at the scope
Hallowed be thy sector
Thy traffic come thy instructions be done
On the ground as they are in the air.

Give us this day our radar vectors
And forgive us our incursions
As we forgive those who cut us off.

Lead us not into adverse weather
But deliver us our clearances
May the TCA, TRSA, and ARTCC be yours
Now and forever.

Out!

Author Unknown

He died peacefully April 10, 2007 17:15 BST

CONTENTS

THE VIRTUAL WORLD

CHAPTER 1

THE VIRTUAL WORLD

When we speak of a virtual world we imagine a world that isn't real, but actually it is real, brought to life by real people with a common interest, in this case flight simulation. We form this world using computer technology, hardware and software, to simulate the surface of the planet and the airspace that encircles it. We make the environment come alive with a sun, a moon, and the stars, rivers, lakes, and oceans, clouds, weather, and climates. Even the sounds of birds can be heard. It is incredible what a couple of decades of development have brought into the common household. Now, no matter where you live as long as you can access the Internet you can join others in a world-wide community that loves to take part in the fantasy of flight. No longer are you bound to the surface of the planet watching aircraft fly overhead; now you can strap yourself in for the ride of a life-time. Let me help you explore this virtual reality called flight simulation.

ESTABLISHMENT OF ATC SERVICES

Using the software I'll describe in this manual just about anyone can setup an ATC service. There are pros and cons to using the software discussed and the limitations imposed are not easily overcome due to the current design and technology it is built around, but with proper management and use the payoff can be extremely fun.

Typically, through the years, not many pilot members within the flight simulator community will elect to pay a subscription for online ATC services, so the bill incurred to support the hardware and host Internet connection must be covered by the owners themselves or by outside income. The hosting software can be run from a personal computer but this would not be an optimum setup. Internet connections better suited to handle the hosting software and the membership growth of an online ATC service will incur more costs. If the service grows large enough then advertising by vendors to the member community might defer some of the costs, regardless supporting an online ATC service can be difficult both technically and financially.

Usually there is a management team, those that have gone to the trouble to setup the hardware and establish an Internet connection to provide the service and incur most of the costs of the operation. This management team typically enlists the help of volunteers to support the operations and activities of the service. They provide the volunteers with limited access once they join to help run the operations of the service.

There are problems related to running an organization based on volunteers. Retention is a primary concern. Because it takes time and effort to train online ATC controllers these volunteers become very valuable over time. Still there needs to be a method to allow the service to operate normally when volunteers do not show for scheduled activities and protect the quality of service provided. In other words can an activity be run with only 5 controllers when 10 controllers were expected to show up? This depends on the methods used to run the activity. Again, using some innovative methods I'll describe how ATC activities can run well with 100+ controllers or with as little as 2 controllers with the software used even on a global wide basis.

So you can see not only the technicalities of establishing and maintaining an ATC service can be a burden plus manning the service with volunteers. All these problems make it difficult to grow a new service. Turning an ATC service into a major operation overnight won't happen in most cases but in the end you can run a multiplayer ATC service with as little as a personal computer and a good broadband connection for smaller groups and have loads of fun!

FSHOST

FSHost is the software used to create the virtual world for flight simulator. It is freeware provided by Russell Gilbert at Chocolate Software http://www.chocolatesoftware.com/fshost/. Pilots connect flight simulator to it using their multiplayer menus and the controllers connect their scopes (FS Navigator) to it using a similar multiplayer connection. This virtual world is created by information and data shared between all connected players.

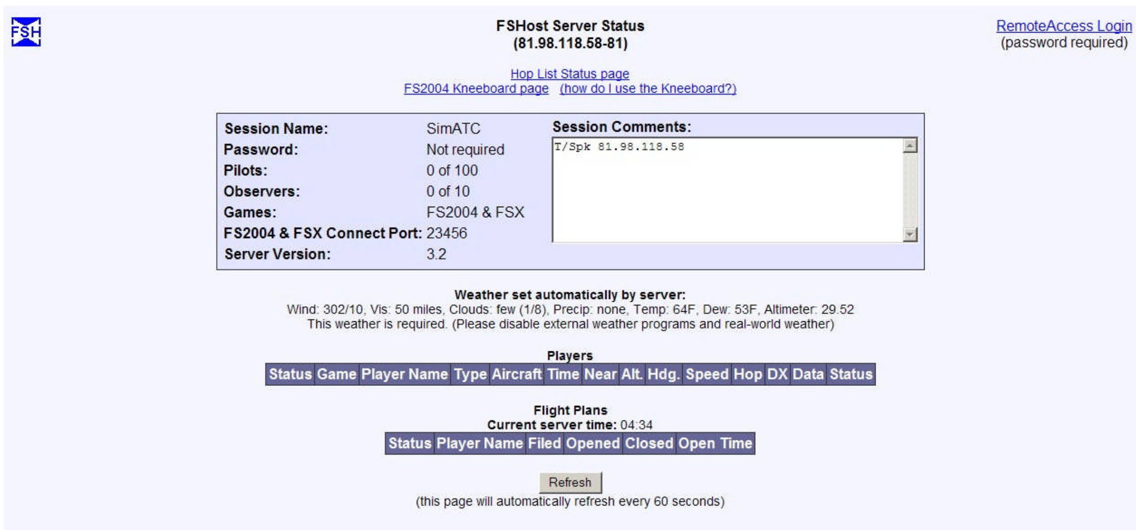


Figure 1 - FSHost public access status page.

THE VIRTUAL WORLD/PLANET

FSHost plays the role of a traffic cop, allowing people into the session, handling chat commands, running hop lists, setting weather and more. The data is sent directly between players, in other words each player sends their data directly to all other players (and the host and FS Navigators) in the session. When a controller connects using FS Navigator the software accepts data sent by other players to be displayed on the FS Navigator map (the radar scope). Each controller can "see" each aircraft position and altitude. By being universally connected FSHost allows each player to send messages to all the other players and provide information to simulate a weather scheme. There are things that are not done primarily due to the differences in flight simulator versions. Such as using squawk codes. Microsoft, for some unknown reason has either added or neglected to pass on certain features, either good or bad, from one version to the other. Hence the difference in what developers can do with each version. So for now we must make the best use of what we have. There are creative developers currently working on free applications that can work around these short comings and will enable us to use such features as squawk codes again but we must cross our fingers and hope that the best and most useful features are brought together in the near future.

AIRCRAFT

As mentioned data from each connected flight simulator is sent directly to the other pilot's simulators so they can "see" each others aircraft. So in a case where pilots come near other aircraft in a session such as when taxiing on the airport or passing each other in-flight they will be able to see each others aircraft. But the aircraft seen (displayed) is conditional, let me explain this by providing some examples.

If two pilots (pilot A and pilot B) are connected using the same version flight simulator such as FS2004 and pilot A is flying a Baron and pilot B is flying a Learjet then they will properly see each others aircraft (pilot A will see pilot B in a Learjet and pilot B will see pilot A in the Baron).

But now let's say pilot A is flying a Lockheed SR-71 Blackbird added recently to their aircraft collection that pilot B does not have, and pilot B is still flying the Learjet. Now when they connect pilot A with the SR-71 will see pilot B in the Learjet (because pilot A has the same default Learjet that pilot B is using) but pilot B in this case will only see pilot A in the same aircraft they're using, the Learjet (because pilot B does not have the same SR-71 pilot A has). If pilot B had the same exact SR-71 in their aircraft collection then pilot B would see the SR-71 pilot A was using.

This accounts for the reason you see some of the other pilots flying the same aircraft you are flying instead of the aircraft they are using on their personal computer, it is because you do not have the same aircraft in your collection. The opposite is true for the other players. If all connected players have the same exact aircraft collections and everyone chooses a different aircraft then everyone will see a different aircraft while flying online. Different versions of flight simulator will have a similar effect.

SCENERY DATA

If everyone installed flight simulator and used only the default scenery as provided then everyone connected via FSHost would see the same scenery data but as in the case concerning different aircraft the same goes for scenery add-ons. Scenery add-ons can add or exclude scenery data causing differences in what pilots see out the window compared to what controllers see on the scope. FS Navigator as mentioned earlier is used as the controller's primary radar scope. The scope display is formed by the scenery and navigational data loaded on the controllers personal computer (not via data from FSHost). The same is true for pilots; the scenery they see outside the cockpit window and the navigational data they use is that available on their personal computer. Figure 2 is a FS Navigator view of the default Atlanta (KATL) airport scenery which shows good taxiways and detail.

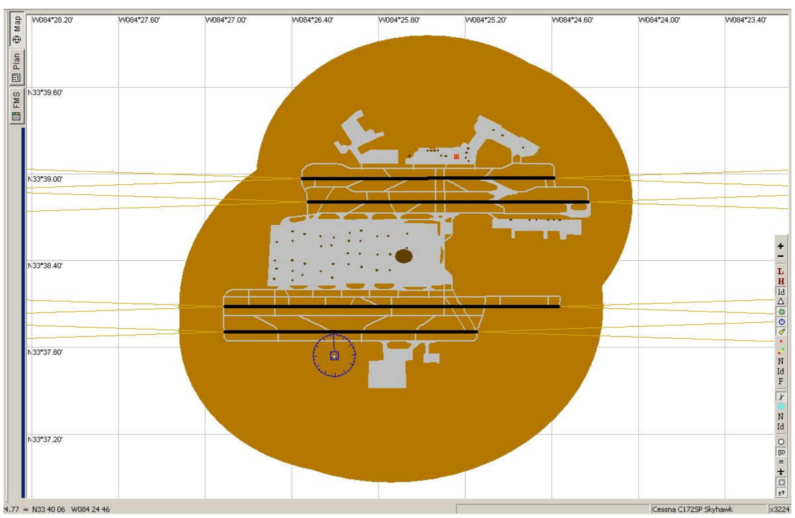


Figure 2 - FS Navigator view of the default Atlanta (KATL) airport.

How does this effect controllers and pilots? Well, when the controller looks at the scope, lets say for an airport where they have an additional scenery loaded, and issues an instruction to taxi to a runway that just happens to be a new runway (say runway 10) then if a pilot using say the default scenery looks for the new runway 10 they may not find it or the taxiways for it. Most likely the first indication that something is wrong will be the pilot calling the controller to tell them they do not have a runway 10. If they are certain they are both at the same airport then the controller will need to either tell the pilot to taxi at their own discretion or choose a runway they both have in their scenery data.

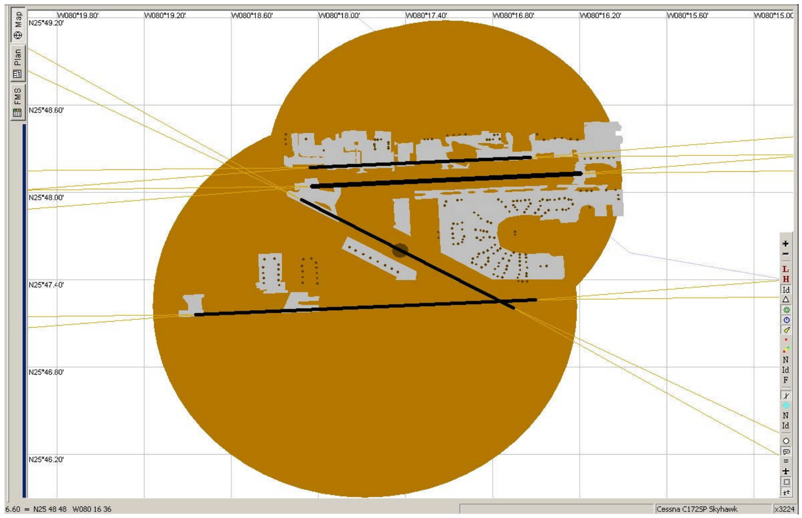


Figure 3 - FS Navigator view of the FlyTampa Miami airport add-on lacking proper taxiway views.

As seen in figure 3 the FlyTampa add-on for the Miami airport scenery lacks proper details for taxiways within FS Navigator which is a nightmare for the ground controllers. This is really a shame because the excellent visual scenery details provided for the pilot outside the cockpit window (reference figure 4) would allow realistic taxi operations if the controller had the same kind of details about the taxiways represented in figure 2 of the default Atlanta Hartsfield (KATL) airport.

Figure 4 - Runway 30 from the pilot's perspective using the FlyTampa add-on scenery.

Another problem is terrain mesh elevations. Now you ask what is terrain mesh and how does it affect elevations? Well, terrain mesh is the *substructure in scenery that gives the ground or a mountain its shape* as seen in the flight simulator. The more accurate the terrain mesh the more accurately you will *see* the real surface (or shape) of the virtual earth. So in other words Mount Everest will "look" like Mount Everest with its pointed top and sharp ridges instead of the more rounded tops and ridges present in default scenery. High resolution terrain mesh can look in a side-by-side comparison just like the real thing.

Figure 5 - Matterhorn Mountain Switzerland as depicted in the default FS9 scenery.

Figure 6 - Matterhorn Mountain Switzerland as shown using FSGlobal 2005 terrain mesh.

Terrain mesh provided via add-ons such as PILOT's FSGlobal http://www.fsim.net/fsim2/index.asp or FSGenesis mesh files http://www.fsgenesis.com/Merchant2/merchant.mvc are allowing the surface of the virtual planet to take on very realistic shapes due to incredible *real-life satellite mapping technology*. If a pilot has these accurate mesh files installed on their computer then the altitudes issued by a controller become much more critical, *so critical that controllers must issue accurate instructions as in real-life*. It requires the use of real world maps and charts. If the pilot or controller fudge this going by "rules of thumb" then they'll probably get to simulate the all too real "pucker factor" also <grin>!

So what are a controller and pilot to do in these cases? Well as in the case of the FlyTampa scenery for Miami the controller would need to issue commands to the pilot to taxi at their own discretion or in a case where the pilot doesn't know where to go provide taxi instructions per clock points such as “straight ahead at your 12 o’clock” or “at your 3 o’clock turn right when able” and so on and let the pilot watch for the correct taxiway out their cockpit window. Cumbersome but it will work.

In the case of terrain elevation it is vital for pilot and controller alike to utilize whatever real-life maps and charts that are available during online multiplayer activities. This is the best way to play but being practical I know many do ***not*** use them depending on personal skill levels. Most real-life charts and maps will suffice with accurate mesh files 99.9% of the time. *I allow .1% for those anomalies that tend to exist within the default flight simulator scenery or even with the available add-on mesh*. For example, there are known discrepancies in the default FS9 scenery where ground terrain shoots straight up from the ground for thousands of feet. The screenshot shown in figure 7 was taken from FS9 after a basic installation. The spike rises to a height of approximately 60,000 feet near the airport of SYKM. If you install a global mesh such as FSGlobal 2005 (or now version 2008) then the spike is removed as the new mesh corrects the problem. Of course flying in IMC conditions with a spike like this in the mist could be a real surprise for the virtual pilot. In such a case, even the best flying techniques or the most skilled controller won’t make a difference. The only other plausible answer is to turn off the crash detection in flight simulator. *If the crash detection is not turned off then this spike will be detected as contact with the ground causing the flight to be reset.*

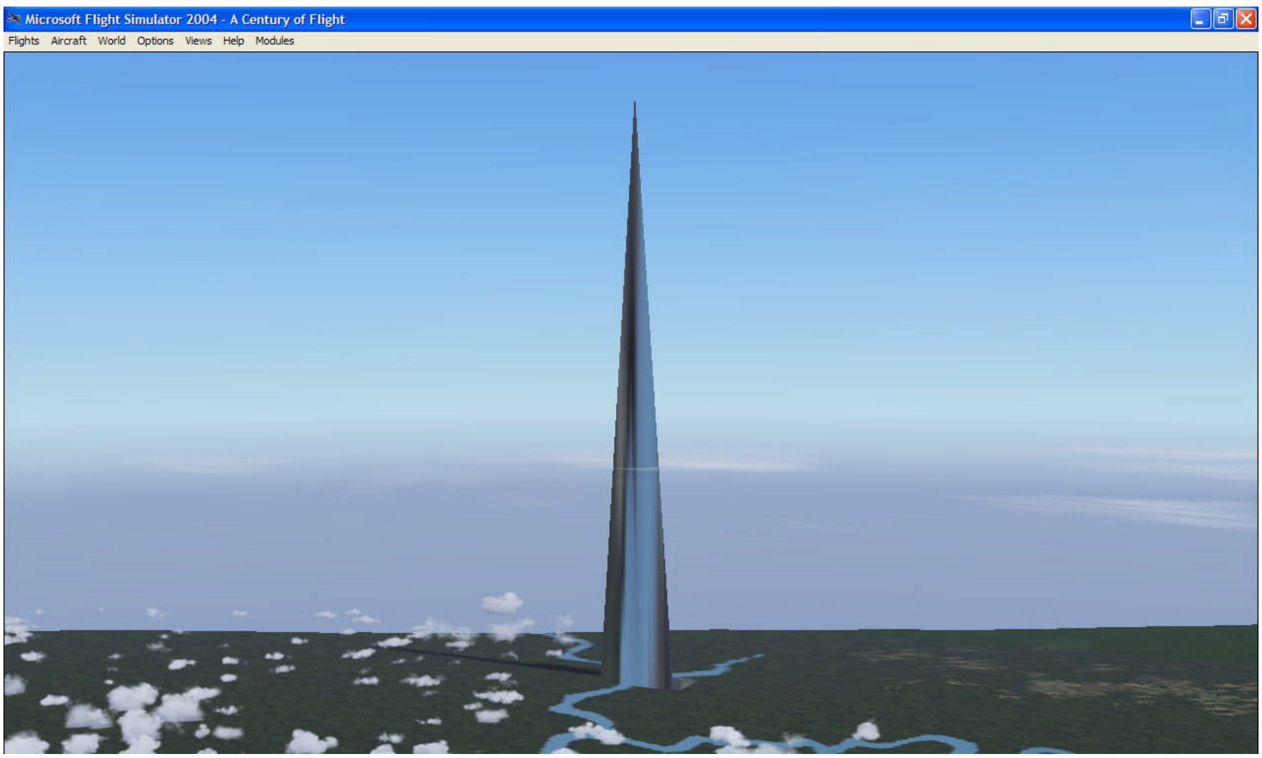


Figure 7 - A 60,000 foot terrain spike in the FS9 default scenery next to SYKM.

So why is the scenery data not centralized on the server so everyone can use the same data and prevent the differences? Well, to send scenery data across the Internet to each client using the server would choke the system due to the streaming of the large data files required to display the scenery for each client. Imagine a web page that is trying to display a bunch of pictures (and I mean lots of them) provided from a central server to your computer at one time, you can understand what would happen trying to display scenery via a server to many online multiplayer clients at the same time. The system would simply come to a screeching halt.

So instead of sending large chunks of scenery files it is better just to send the coordinates back and forth between players and then render the locations using the scenery present on the local computer.

Another issue about scenery is the differences between the flight simulator versions. Scenery can be different between FS2002, FS2004, and FSX where one version might have a building in the middle of the runway and in another maybe not have the airport at all. This will be a factor when different versions connect to a single multiplayer environment.

So in the end most everyone is confined to use the scenery on their personal computers. What the controller “sees” on the scope and what the pilot “sees” out the window will be two different things unless they have the exact same scenery. To overcome this problem as best possible each online ATC service must use methods to train controllers on how to get around the differences with minimum impact to activities. *Maps and charts should be utilized as much as possible by both pilot and controller to enhance the overall experience*.

SIMULATING WEATHER

When we think about weather as real pilots we normally think of Mother Nature being very unpredictable, and at times very unforgiving. We try to obtain the latest forecasts to be better prepared but once airborne the pilot and aircraft are subject to sudden changes in weather that possibly can turn into real trouble. This creates one of the greatest challenges for real-life pilots.

Simulating this unpredictable nature of weather would provide the greatest realism possible for online pilots. In the virtual world weather scenarios can be simulated by FSHost but there is a problem, FSHost does not currently (at the time of this writing) provide real-world, real-time, station based weather to all the clients. This of course would be the best scenario by far for everyone. In the FAQs on the FSHost site the question is asked if real-world weather is available and the author Russell Gilbert answers it by saying “At the moment, no. But I hope to add this feature some time soon.” This would be a hoot for online ATC activities.

An alternate possibility is to have everyone use their own personal real-time weather programs at the same time and hope that the weather data matches, not bad but certainly not ideal. The best way would still be to have a real-world, real-time, station based weather feed from the host supplying all the clients the same exact data at the same time during an activity. This way the weather “reported” to the pilots and controllers about each weather station via FSHost would be exactly the same for everyone. The neat thing about station based weather is while the pilot flies along the route weather seen out the left window can be different than that out the right window. Once again pilots can arrive at their destination airport not knowing for sure they can make a successful landing or be forced to divert to their alternate airport.

Besides everyone trying to use individual weather programs there is weather available via FSHost but it is currently limited to a “global” scope, meaning once the weather is set the same weather is fed to all the weather stations within flight simulator at the same time and doesn’t change without manual intervention either by an administrator or automated program.

There is a utility available written by Jon Finch that allows different weather schemes to be programmed that will cycle at predetermined times as indicated in a schedule. This is best used during times when no administrators (controllers) are available to keep the weather changing for pilots. During “live” activities the administrators (or controllers) can set the weather parameters on the fly to present various challenges to the pilots.

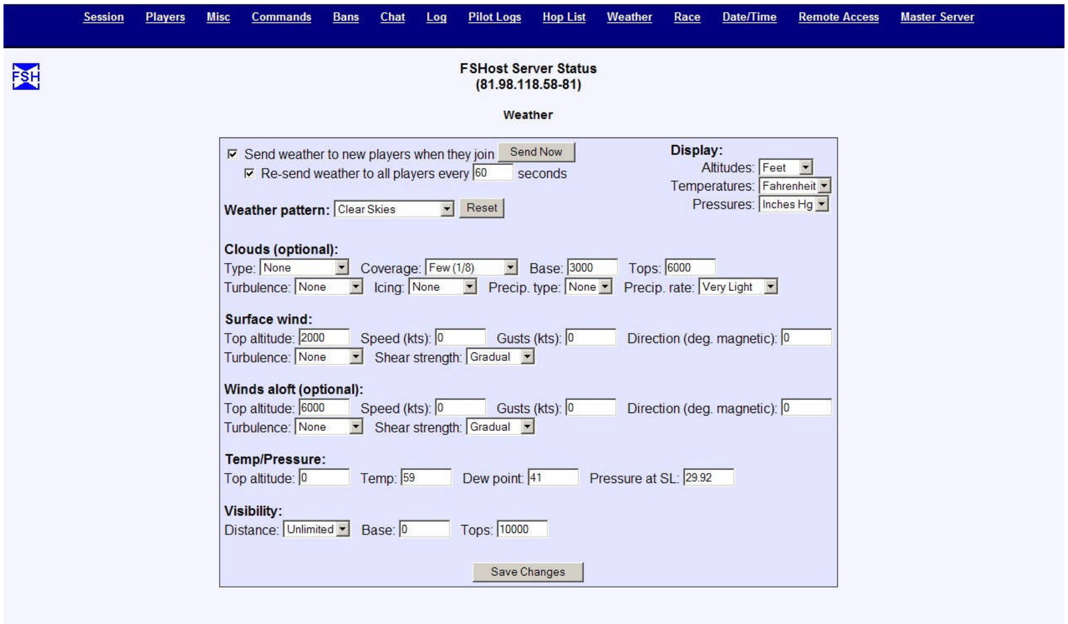


Figure 8 – FSHost Weather Page.

What might happen is the controller manipulating the weather might set it for marginal VFR at the start of an activity and sometime during the activity setup an IFR weather scenario that would challenge pilot skills during landings. As seen in figure 8 above most of the important settings for weather are readily available.

FLIGHT PLANS

Another important aspect of FSHost is filing pilot flight plans. Pilots file flight plans via their chat window in the flight simulator when connected to FSHost by entering the **+fp** command at the beginning of the line in the flight simulator chat window. This will cause FSHost to recognize the data being received to be that of a flight plan. If you need a list of all FSHost commands available just type **?help** into the chat window and press ENTER.

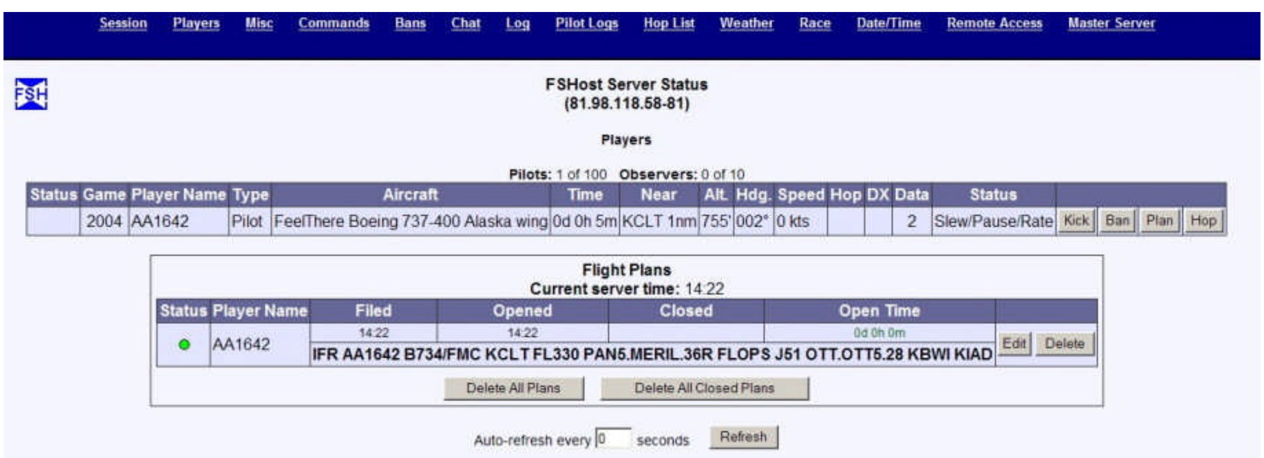


Figure 9 – Administrators Flight Plan page in FSHost.

The trick to flight plans is good data input and formatting but there are problems involved. Microsoft (the developers of Flight Simulator), even though they included a flight planner in the simulator did not provide a decent method to have this information transmitted during multiplayer activities, oops! So what happened is the author of FSHost came up with a method to “trap” unique codes (such as the **+fp** command) sent via the pilots chat window to be used by the FSHost software. When the **+fp** command is transmitted via the chat window FSHost will trap all the data following the code until it reaches the end of the data stream which would be recognized like a period to a sentence (the period in this case is created when you pressed the ENTER key). Then the FSHost software can process this data as a flight plan actually placing it into the FSHost Flight Plan page as shown above. The problem with this is the "data string" is not formatted or checked for accuracy and completeness; it is taken "as is". That problem is a can of worms for online controllers trying to sort out flight plans entered by pilots in as many different ways as there are pilots. This is one problem that needs the software designed to help control the final output and accuracy so it is more easily read by controllers (and I speak from experience). New client-side programs may help with this problem by allowing a form very similar to an FAA Flight Plan form being available to the pilot to file a flight plan, then having the program code format the data to be sent to a program used by the controllers and displayed in the form of a flight plan strip more easily read and used by controllers.

This is not to say that Microsoft didn't do a good job with the flight planner they have in the flight simulator now but it would have been *GREAT* if they had went ahead and made a replica of the true FAA Flight Plan form for pilots to fill in. Then had the program format the data to some extent and not stop there but provided a way to transmit the data in a format similar to an Air Traffic Control flight strip for use by external programs besides the forms required for use by the simulator pilot.

It is vitally important that until such methods can be provided that each pilot closely follows the ATC services guidelines on filing their flight plans. It only hurts the activities by frustrating the controllers to no ends trying to quickly sort through the entered data to pick out the information required. If all flight plans were entered equal then controllers only need to read each flight plan the same way each time to quickly obtain the data. Besides, there are other short comings dealing with flight plans, because the flight plan data is not displayed on the controllers scope (FS Navigator) it means the controllers must keep a browser window open at all times to get at this data on the FSHost server. Each extra open window in flight simulator reduces not only computer performance but makes more work for the virtual controller because there are several open windows at one time to manage an ATC session.

It should be noted not all the fields in a real-life FAA flight plan would apply to a single or multiplayer activity but what the heck, if provided then the virtual pilot can decide how much information they wish to simulate. I'll discuss flight plans in detail within chapter 3 Common Elements of VFR and IFR flight.

BANDWIDTH CONSIDERATIONS

When connecting everyone together there are things to consider about bandwidth and streaming of data to and from each client connected. Depending on the number of connected players and what they are using to connect with (Flight Simulator, FS Navigator, or ATC Radar Screen) will set the upper limit of bandwidth required for each player. I'll examine some of the author's notes and provide some examples to try and clarify this, take this note from the FAQ section of the FSHost web site:

Even though FSHost supports an unlimited number of players in the game, you'll probably hit a bandwidth limit long before you approach the "unlimited" level :-) Since Flight Simulator works in "peer-to-peer" mode, the server does not relay the messages between the players -- all messages are sent directly from one player to all other players in the game. This means that every time another player (or even another add-on like FSNavigator) connects, all players in the game start sending their data to that new player also.

So when a pilot using flight simulator or a controller using FS Navigator connects to FSHost the data from ALL the other players, except other FS Navigator users, starts rushing to the newly connected player. *When FS Navigator is connected to FSHost it primarily receives data but does not send data.*

Now there are differences depending on which version of Flight Simulator you are using. Take a look at this note about FS2002 from the site:

FS2002 sends location data four times per second. It's not possible to predict exactly how much bandwidth you'll need for a certain number of players, but a rough estimate seems to be about 1 to 1.5 Kilobytes per second, per player in the game. The observer built into FSHost, and add-ons such as FSNavigator, only receive data and don't send it, so they're more like a half of a connection, each.

So what does this mean in terms of bandwidth use? Well, let's take a simple example. Let's say we have 3 players in a session, each of which requires 20 units of bandwidth. When you multiply this the total is 60 units. If three controllers are also connected, each of which requires 10 units of bandwidth (remember, FS Navigator only uses half the requirement of 20 units), then when multiplied they use a total of 30 units. So now we have a total of 90 units used by both pilots and controllers. If ***each*** player (this includes the hosting computer) has the capability to handle 100 units of bandwidth then all is well but what if two of the pilots crank up their personal copies of FS Navigator so they can follow each other in-flight. That requires an extra 20 units for a grand total of 110 units. Now ***anyone*** connected who has a bandwidth capability less than 110 is in trouble because the total bandwidth requirement for the whole session has reached 110 units.

The only way to fix this is for those players to add more bandwidth until the entire session requirement can be met (and that costs money) or tell pilots they must refrain from using FS Navigator as in this case. As nice as it is for the pilots to connect their copies of FS Navigator to follow each other as a group it is just as easy to get the controller to provide that information by indicating you wish to fly together in formation. The controllers can allow this by telling the pilots they are responsible for their own safe visual separation during formation flight and provide radar vectors when they become separated.

There is another consideration indicated by the developer of FSHost. Take a look at this note from the site:

FS2000 and FS2002 sent their data at a fixed rate of four times per second, but FS2004 sends its data at the same rate as whatever frame rate you're getting in the game. So if FS2004 is displaying 50 frames per second, it's also sending data to all other players in the session at a rate of 50 times per second, which is ridiculously high, and certainly could be considered a bug in FS2004. You can check your current frame rate by typing Shift-z twice, which will cause the information to be displayed with red text in the upper left corner of the screen. The only way to prevent FS2004 from sending data at such a high rate is to lock the frame rate to a reasonable maximum number of frames per second. To do this, go to the Options menu, then Settings, then Display, then select the Hardware tab, and set the "Target frame rate" to a number such as 20 or 25 (or if you're at the startup screen and not yet in the plane, click Settings in the lower left, then Display and then Hardware). You probably won't be able to see a difference above this level anyway, and by keeping the data rate lower, you'll not only be helping prevent other players on slower modems from being overrun with unnecessary data, but it may also help with the disconnect problem.

This same point is emphasized again in another note from the developer here as follows:

FS2004 sends location data at the same rate as the display frame rate in the game. ***This is, without a doubt, a bug in FS2004.*** *Some users on 3 GHz machines are able to get 100 frames per second or more, which means they're sending location data to all other FS2004 players at a rate of 100 times per second also. There are very few things in life that should be done 100 times per second, and sending Flight Simulator location data half way around the world over the internet is definitely not one of them. The only way to prevent your own FS2004 from sending data at this ridiculously-high rate is to go to Options / Settings / Display / Hardware, and set the "Target frame rate" to a more reasonable level, such as 20 or 25 frames per second. This also makes it impossible to predict what kind of bandwidth will be required to host an FS2004 session.*

Now let me make sure you understand the two different rates here. First there are frame rates per second (FPS) that many of us are familiar with where it concerns how our flight simulator is displayed in visual terms and then there is data packets per second, the rate at which data is sent from the simulator in this case. By capping the rate at which the data is streamed it helps prevent choking the system. Apparently the way this was done in FS2002 was by a timer that went off every 250ms (4 times every second) that told FS2002 when to send the data out (data bursts) but when FS2004

(FS9) came along for some reason this feature to cap the data rate doesn't work. FS9 is sending the data out at the same rate as the visual frame rate (hence the developers note, "***This is, without a doubt, a bug in FS2004!"***). In other words every time FS9 refreshes the screen display it sends the multiplayer data stream and this too can choke the system!

So that brings us back to frames per second (FPS), typically a measurement of display rate. In the world of theater and projectors it is know that running 35mm film (a continuous collection of 35mm stills on a single reel of film) through a focused beam of light pointed at a silver screen at 24-28fps makes for fluid movement of the characters and scenes caught on the individual stills). So it is on your monitor. The scenes developed by the video card are displayed at whatever frame rate per second (FPS) that the computer can muster. If your FPS is high the flight simulator display is smooth (your eye can not see each frame being drawn on the monitor) but if low will be like a stutter as each frame is displayed at low enough a rate that your eye can catch it.

So, players connected into a multiplayer session using FS9 will pass their data to all the other players at the display rate set for TARGET FRAME RATE found under the OPTIONS>SETTINGS>DISPLAY>HARDWARE tab. This means if a player has the rate set for 50fps then the data stream is going to be sent out 50 times per second (not good as Maynard would say!). This will stuff the data pipe full causing possible problems.

So how do we solve this problem? The answer is simple when it comes to multiplayer activities. Each pilot connected using FS9 must set their target frame rate to not greater than 25, preferably 20. That way the data sent from each FS9 user is sent at a rate of 20 times per second (still much faster than the 4 times per second as done in FS2002). The author has mentioned possibly providing code to limit the FS9 transmission as is done in the FS2002 version in a future release.

There are many discussions about what is the proper or desired display frame rate setting for flight simulator for reasons other than discussed above which goes far beyond the scope of this manual but I would like to provide two links to articles by Steve Lacey concerning "blurries" and "stutters" well connected to the target frame rate setting. If you want to know who Steve Lacey is check out his bio information.

Steve's bio is available here http://www.steve-lacey.com/bio.shtml
"The Blurries" is located here http://www.steve-lacey.com/blogarchives/2005/11/the_blurries.shtml
"The Stutters" is located here http://www.steve-lacey.com/blogarchives/2005/11/the_stutters.shtml

Depending on some systems hardware a setting of "unlimited" may be recommended. Again this will not do in our case for multiplayer activities using the current version of FSHost, but if you are playing single player activities by all means switch your display frame rate to your liking.

Now what about those with a slower 56K modem? Well, I would like to make a recommendation. If your going to get heavily involved with multiplayer activities then get yourself a broadband connection otherwise prepare to be frustrated. The developer puts it more nicely as follows:

If you're on a 56K modem connection, you'll probably start having problems when you get above about 5 or 6 players. Planes will start jumping around in the sky, because your game isn't getting the data quickly enough to show them in the proper position. If it gets bad enough, you may not see a particular player at all, or they may drop out of the game.

When it comes to FS Navigator the developer points out some specifics as noted here:

FSNavigator works exactly the same way that FSHost's built-in observer player works. They both join the game and only watch the messages from the other players, but they don't actually send any messages themselves….when you connect an add-on like FSNavigator to the game, all other players will start sending messages to that new player as well, which increases the amount of traffic required for all players in the game. However, FSNavigator doesn't send any of its own messages, so the traffic is only increased half as much as it would be if another FS was connected. I haven't seen any evidence to suggest that FSNavigator causes any *slowdowns or instability in the game. Sometimes people think that it causes disconnects, but my theory is disconnects are just more likely to happen when the required bandwidth level gets to a certain point. By keeping a low number of players (or add-ons like FSNavigator) in the game, you also keep the bandwidth level low, and reduce the chances for mass disconnects.*

You can, as an administrator, block out FS Navigator connections within FSHost as noted here:

If you decide you want to block FSNavigator connections, there's a feature in FSHost on the Options/Game window to do so.

One further note off topic here, realize we are just talking about FSHost. If the administrator has TeamSpeak (the communications hosting software) loaded on the same computer (server) then this will also compound the problem of using up available bandwidth. I prefer the two hosting applications be run on separate computers for many reasons but still the overall available bandwidth from the ISP may not be any better than with one machine unless a true high speed connection (both up and down links) is available. I'll discuss things that can make the use of TeamSpeak more efficient when we get there.

CONNECTING FLIGHT SIMULATOR TO FSHOST

Below is the connection example provided on the FSHost web site. I won't discuss the connection process for FS Navigator here although similar, as I provide that information during the discussion about FS Navigator. Also I do not discuss troubleshooting so if you do run into a problem then refer to the FSHost web site for further information http://www.chocolatesoftware.com/fshost/.

When someone connects to your server, here's how they do it. First they start the game themselves. Then they click on "Multiplayer" and then "Open multiplayer session" (or Flights / Multiplayer / Connect, if they're already in the plane). They should see a window like the one below. First they should type in a player name. Then they should type in your IP address (from the log window above), and click Search. After a second or two, they should see your session come up in the "Sessions" box. Then they can click "Join" and it'll connect to your FSHost.

Figure 10 - FS2002 Multiplayer Connect Screen (FS9 is very similar).

In summary we have covered the more primary aspects of FSHost that concern the pilot and controller. FSHost brings all the players together allowing them to see each others aircraft either as a pilot or controller, it provides a means to set the weather to create challenging flight scenarios and provides a way to allow pilots to tell controllers the intended routes of flight via flight plans. We discussed the pros and cons of using bandwidth more efficiently. Managed properly the virtual world can be a fun place to play for all.

TEAMSPEAK

TeamSpeak is freeware used as the hosting software to provide all connected players a verbal and text capable communications environment (visit http://www.goteamspeak.com/). TeamSpeak provides a unique communications environment because it allows the administrators to create audio channels that simulate real-life radio frequencies used to provide communications between pilots and controllers. By using TeamSpeak in conjunction with a small utility called TSComSet a pilot can change these frequencies via the radio panel located within the aircraft cockpit. TeamSpeak also provides a unique means for controllers to communicate "in the background" to coordinate ATC operations very efficiently.

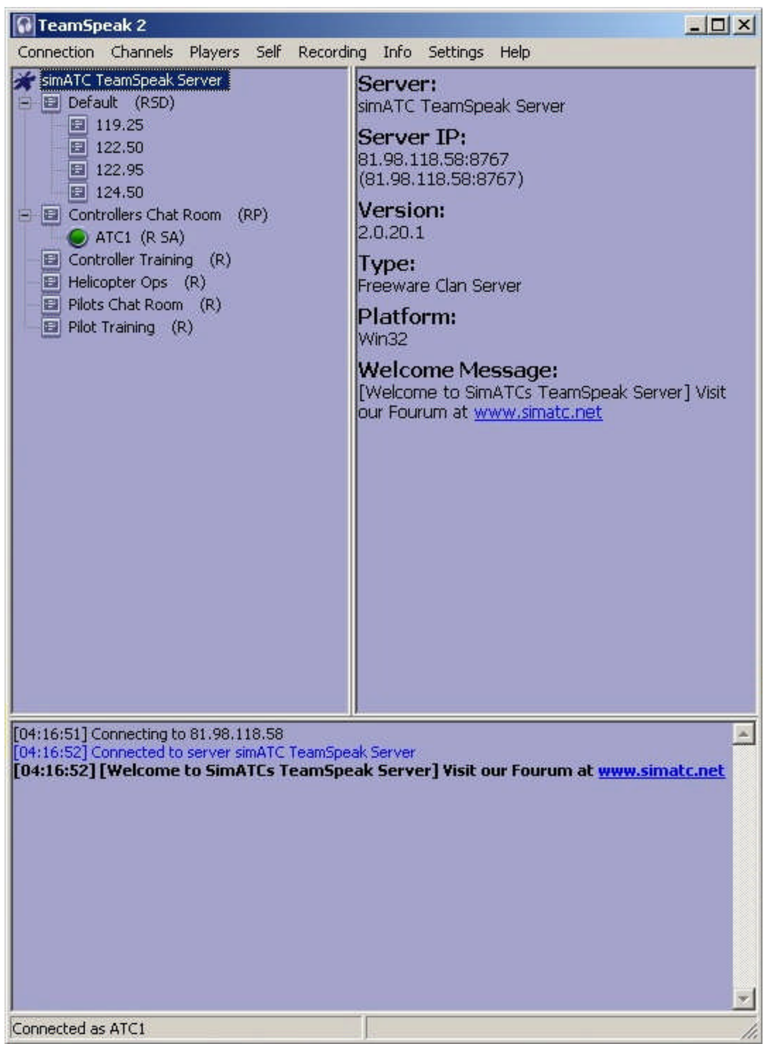


Figure 11 - TeamSpeak client main screen.

TESTING YOUR MICROPHONE

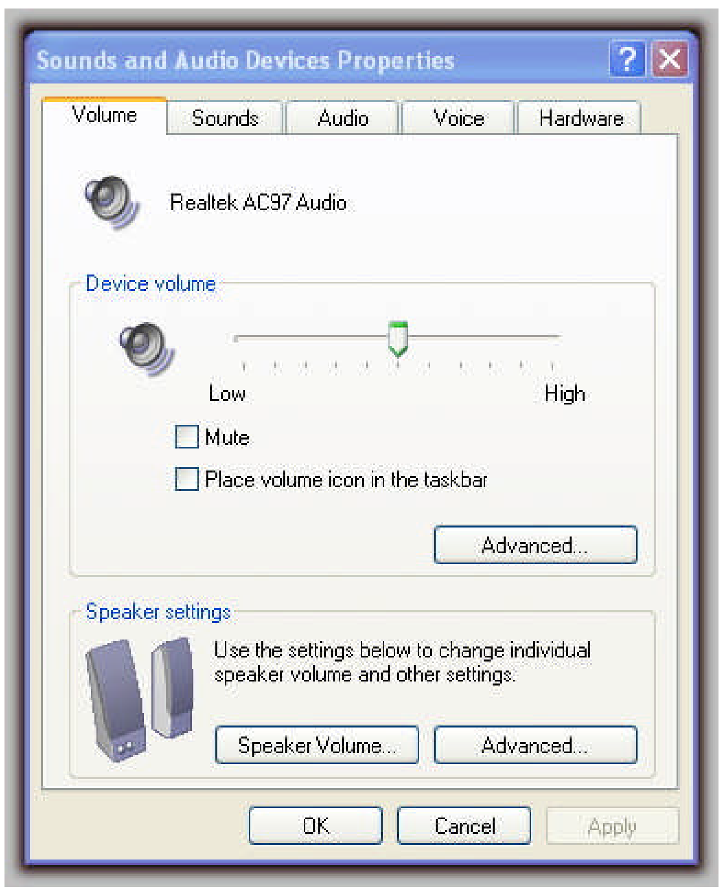
Each pilot that wishes to participate in ATC multiplayer activities needs to download and use the TeamSpeak client. Many ATC services will provide the client along with any other utilities such as TSComSet (used to change frequencies via the cockpit radio panel) or TSNoise (used to create a realistic squelch sound) and other special instructions for its use during scheduled activities. Setup for the pilot tends to be straight forward but there are things to pay attention to for successful operation of TeamSpeak from the start.

First and always I recommend a good headset with a boom microphone. It doesn't have to be expensive believe it or not, and should be comfortable to wear for extended periods of time. Typically such a headset will have two separate plugs, one for the headset ear pieces and the other for the microphone typically color coded green and pink respectively. Make sure you get these plugged in properly to your existing computer sound system.

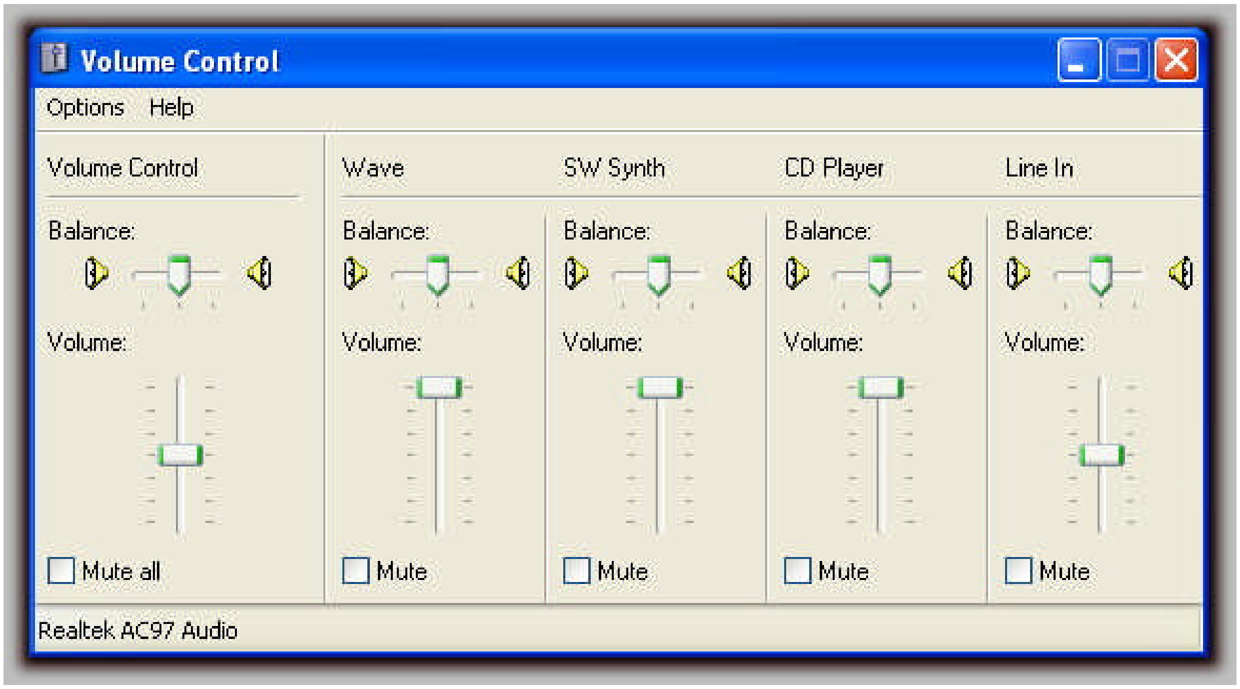
The next step is to test the headset and microphone, first in the Windows operating system, then within the TeamSpeak client. If it doesn't work using the test provided in Windows then you can pretty much hang it up working with TeamSpeak. If you ever have problems with TeamSpeak and can not quickly resolve the issue then this will again be the basic first step to troubleshoot any audio issues before returning to TeamSpeak to check its setup.

So let's start with doing the check of a headset within Windows.

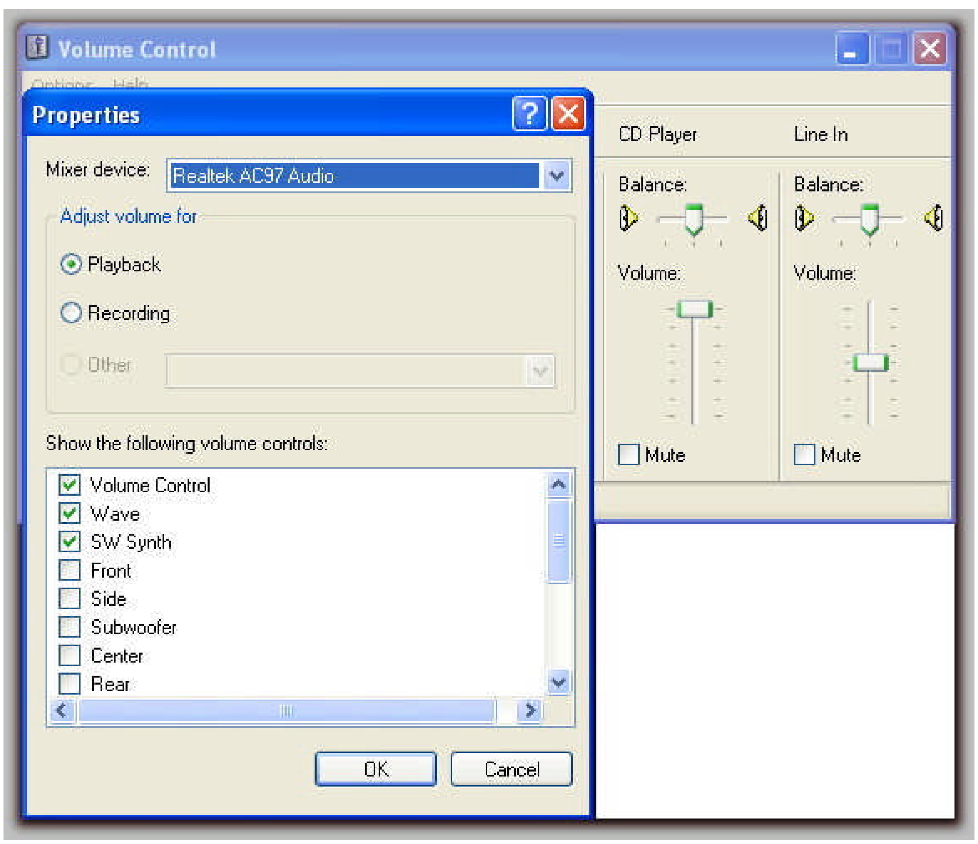
Step 1. Open the screen below by clicking START>CONTROL PANEL>SOUNDS AND AUDIO DEVICES. Then click the ADVANCED button in the "Device volume" section. This opens the window in step 2.



Step 2. In the upper left corner click on OPTIONS and then PROPERTIES. This opens the window in step 3.

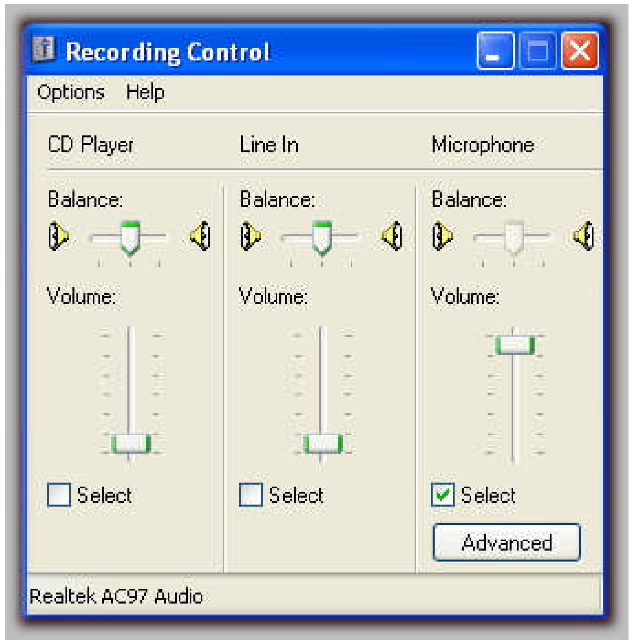


Step 3. In the Properties window make sure to check the proper volume controls in the section "Show the following volume controls" then click the bullet mark for RECORDING and then OK. This will display a window similar to the one in step 4.



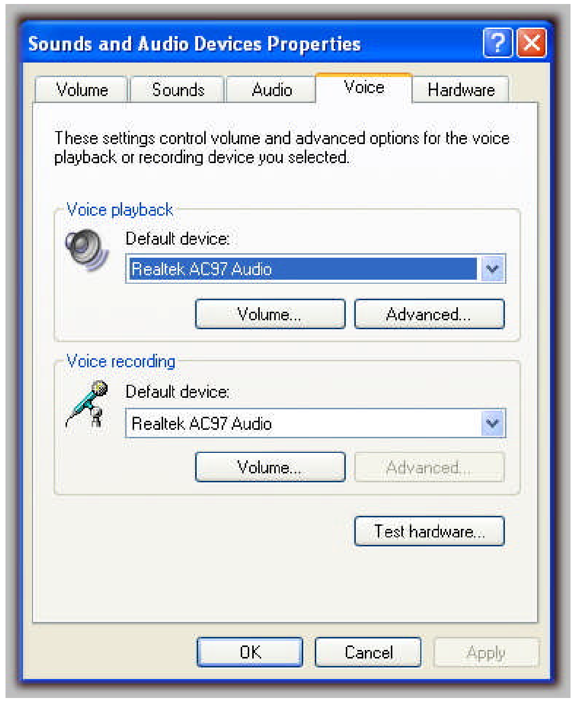
Step 4. In this window make sure the "Microphone" is checked. If you don't see the microphone volume control displayed, go back one window and ensure you checked the microphone volume

control. Once that is done click on the ADVANCED button under the volume control. This will open the window in step 5.



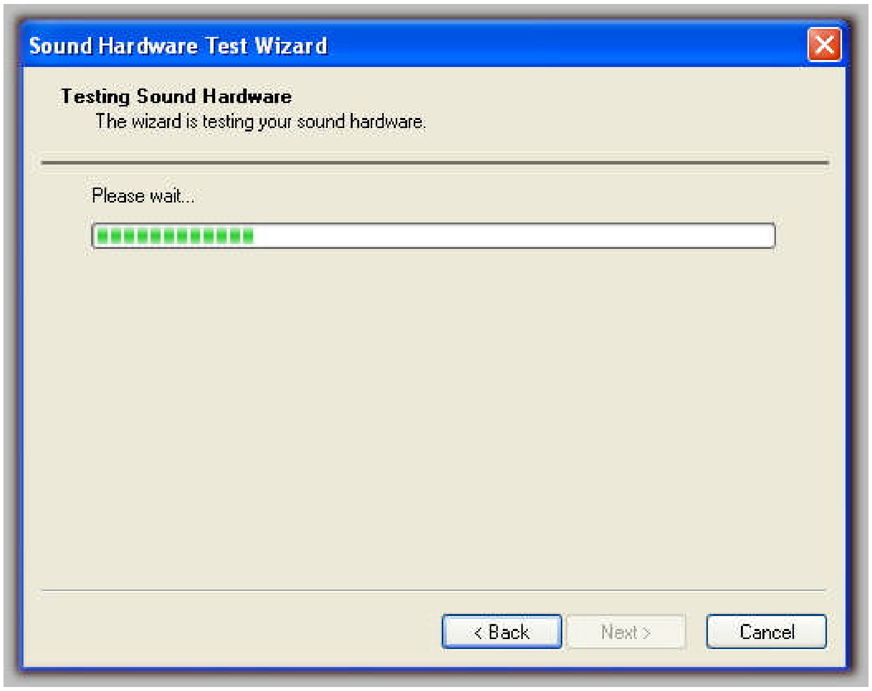
Step 5. In this window is a very important option in the section "Other controls". If "Mic Boost" is not checked, check it. This, depending on your microphone and sound hardware can make a difference in hearing your voice or not. Click CLOSE. Close ALL remaining windows.

Step 6. Okay, back to the control panel and reopen SOUNDS AND AUDIO DEVICES. Click on the tab along the top labeled "Voice". In the pull down menu located in the section "Voice Recording" ensure whatever device your microphone is plugged into (usually your onboard audio or a plug-in sound card) is selected. There can be other microphone devices that will show up in the list. An example would be a built-in microphone on a USB camera. The bottom line is to select the device your microphone uses. In the shot taken I have my onboard RealTek AC97 Audio chipset selected because my microphone plugs into it. Now click the button TEST HARDWARE. This brings up the next screen in Step 7.

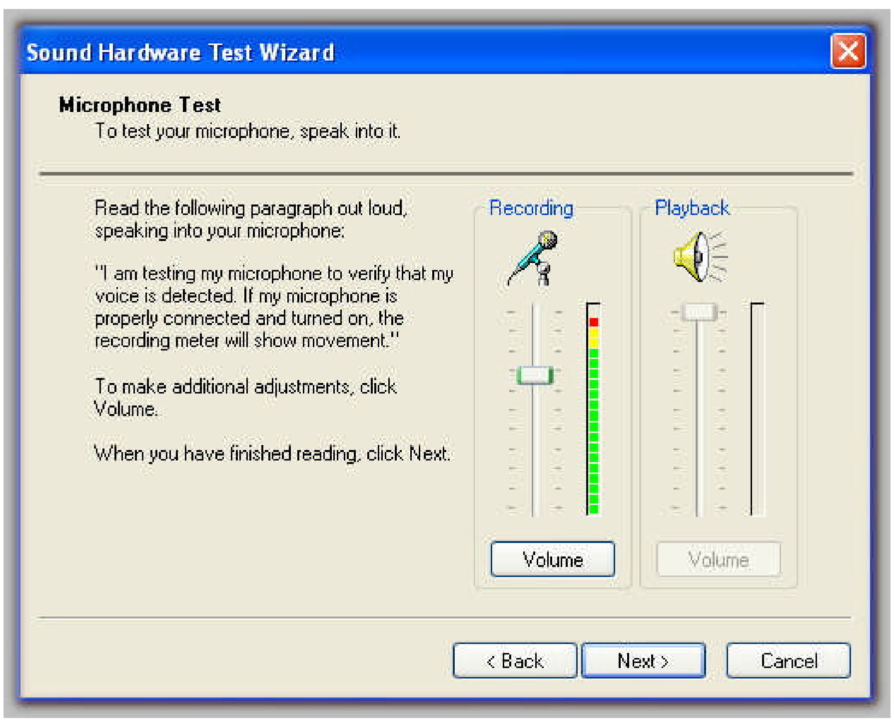


Step 7. As you can see we have started the “Sound Hardware Test Wizard”. Confirm the proper sound hardware is recognized in this window for your recording half. Click NEXT when confirmed. That will display the screen in step 8.

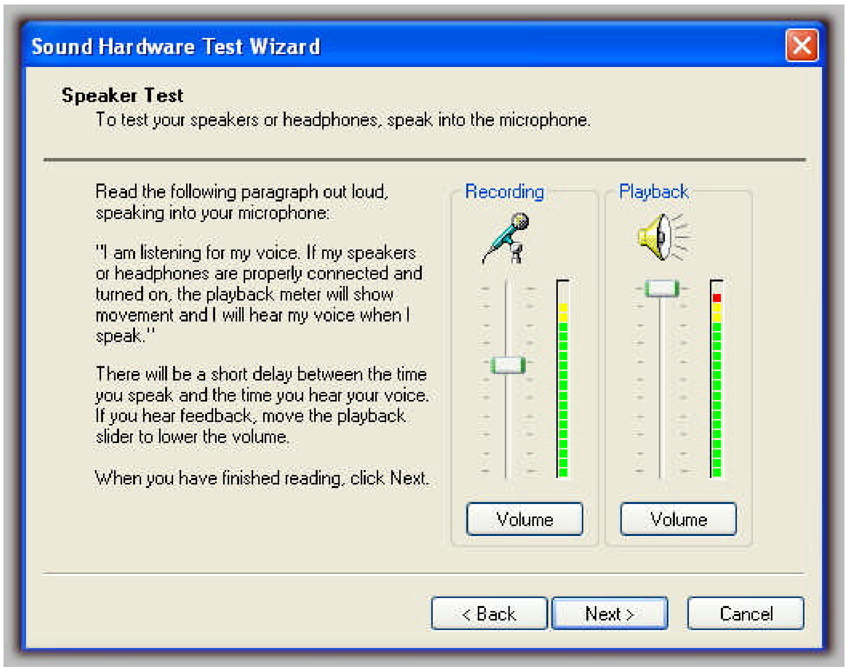
Step 8. Windows will run a short test routine on the sound hardware. When complete click NEXT to display the screen in step 9.



Step 9. Follow the instructions on the screen. If you click the VOLUME button it will take you back to the screen in step 4. If you uncheck the “Mic Boost” you will see the difference it makes in your mic volume (usually a pronounced difference). In any normal system, working correctly, you should be able to peg the meter talking *directly* into the microphone at normal levels. If you only get a slight movement or none at all try a microphone you *know to be working* at this step. If you still can’t get it to work you have a deeper problem that goes beyond the scope of this check. When this is working correctly click the NEXT button to display the screen in step 10.



Step 10. In this screen you test the microphone audio by listening to yourself talk (I don't recommend talking to yourself to much, not a good sign <grin>). What is important here is that it checks the internal audio circuitry by running a loop test. If you see the mic audio meter maxing out but nothing on the playback meter, but can get audio by playing say an MP3 then again, you most likely have deeper problems, maybe the onboard audio chipset or the plug-in sound card. Chances are if you have good playback on other devices such as an MP3 file playing through a CD drive you won't have a problem (the problem I describe here is rare). If this checks okay, then click NEXT to see the final screen in step 11.

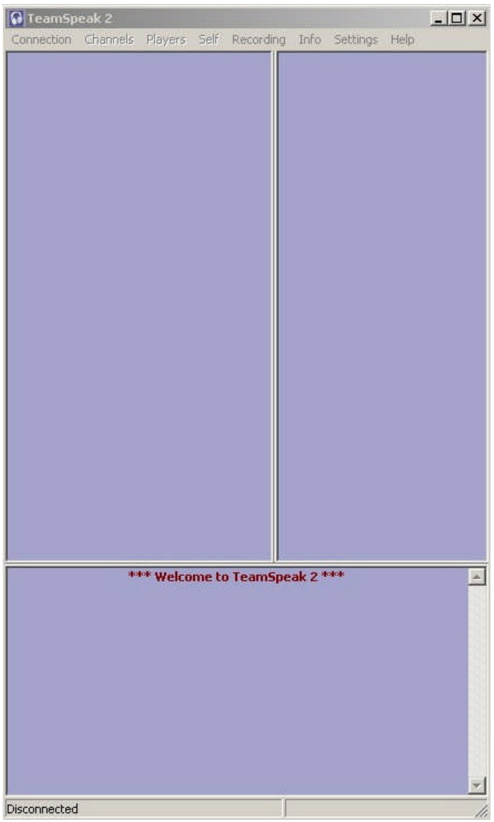


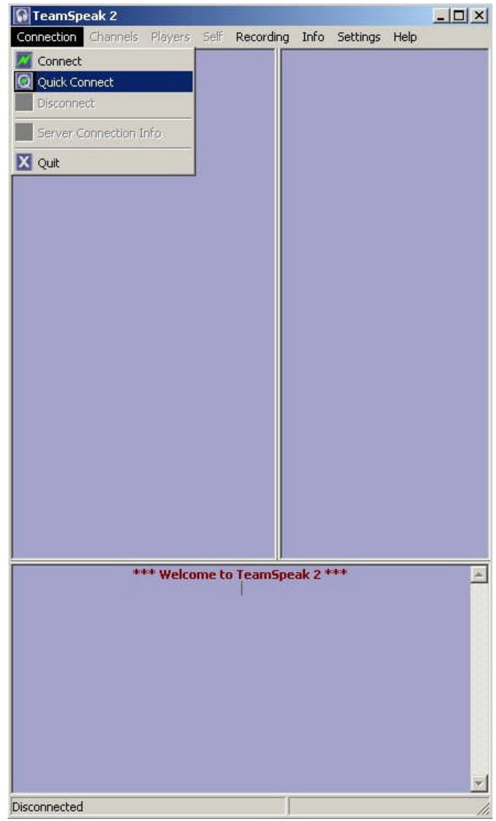
Step 11. Your microphone is working correctly (as far as Windows is concerned) if the test wizard runs without a hitch. Now we can return to setting up and checking the operation of TeamSpeak.

QUICK CONNECTING TO A TEAMSPEAK HOST

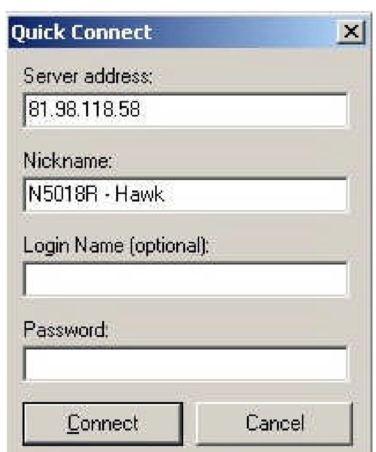
Now I will discuss setting up TeamSpeak from the pilot perspective. Setup for Controllers is slightly more complex and will be covered in a later chapter. A pilot only needs to "Quick Connect" as a user to get up and running. So let's get started.

Step 1. Open TeamSpeak to obtain the window shown on the left below.





Step 2. Then click on Connection in the upper left corner and highlight and click Quick Connect as shown on the right above. This will open a window as shown below.



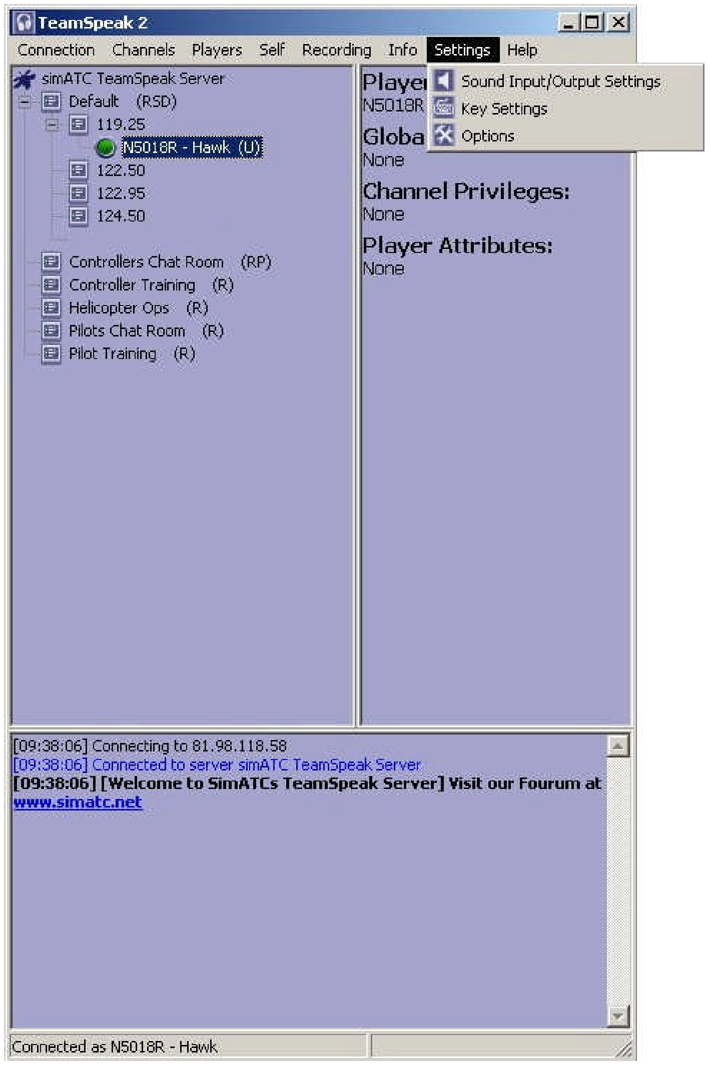
Step 3. Fill in the Server Address data field with the IP address of the host server. The IP address above is that of SimATC at the time of this writing. In the Nickname data field put the aircraft identification as prescribed by the ATC service guidelines. In this example the aircraft identification is

N5018R. Most users will put a name after the ATC service required identifier but mostly is optional. When finished click on Connect. You should be immediately connected if the host server is up and running (not down for maintenance or storms) and see a window similar as follows.

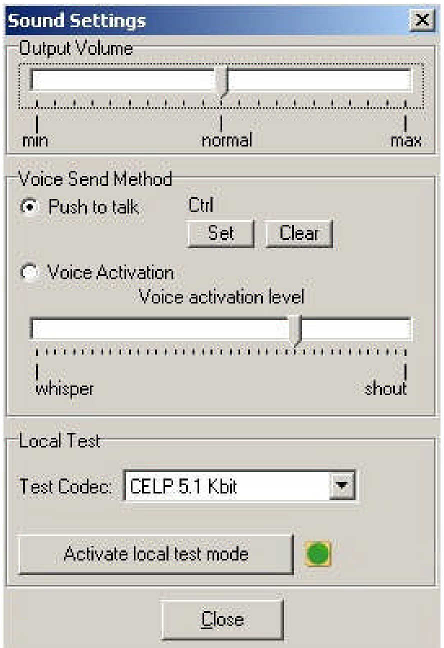
Typically you'll be placed straight into the default channel depending on the server configuration. Even though the default channel frequency is not shown (only indicated by the label DEFAULT as above) it does have an associated frequency, in this case the default frequency is 118.00.

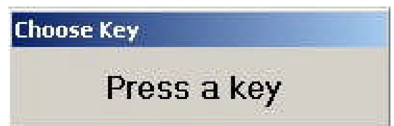
SETTING UP TEAMSPEAK

Step 1. Now the pilot needs to configure the key that will be used as the push-to-talk (PTT) button in TeamSpeak. To do this the pilot must click on Settings as shown in the next screenshot, highlight Sound Input/Output Settings and click it. The PTT key is what allows the audio from the microphone to become active and transmitted to others in the channel. As seen in the screenshot below there is a small round green indicator next to the user identification. This green indicator will turn bright green when the key selected as a PTT key is pressed to indicate the microphone is active and that others should be able to hear you.



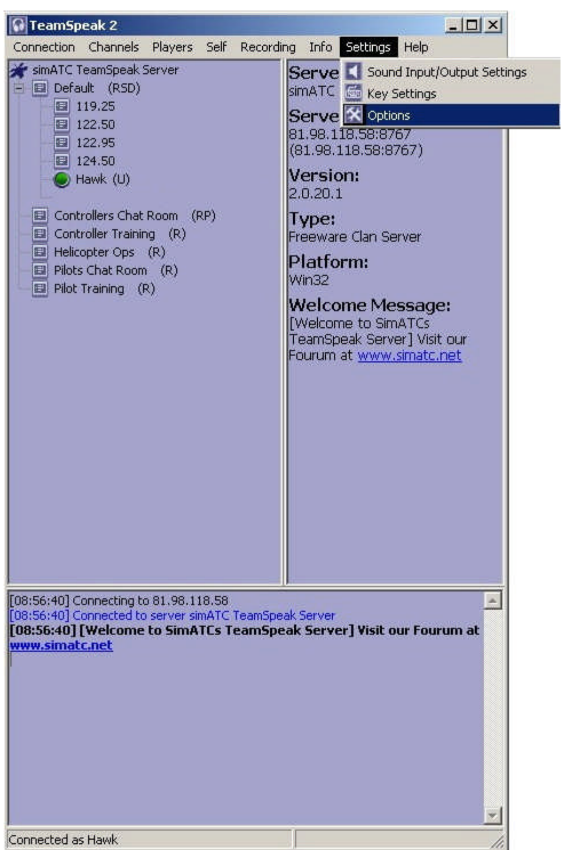
Step 2. As seen in the screenshot below on the left you need to select the Push-to-Talk bullet in the "Voice Send Method" section. Then click the Set button which will show the small window on the right below. At this time the very next key pressed will become the selected PTT key. If you make a mistake just press the Set button again, then press the key you wish to use. Then click Close.

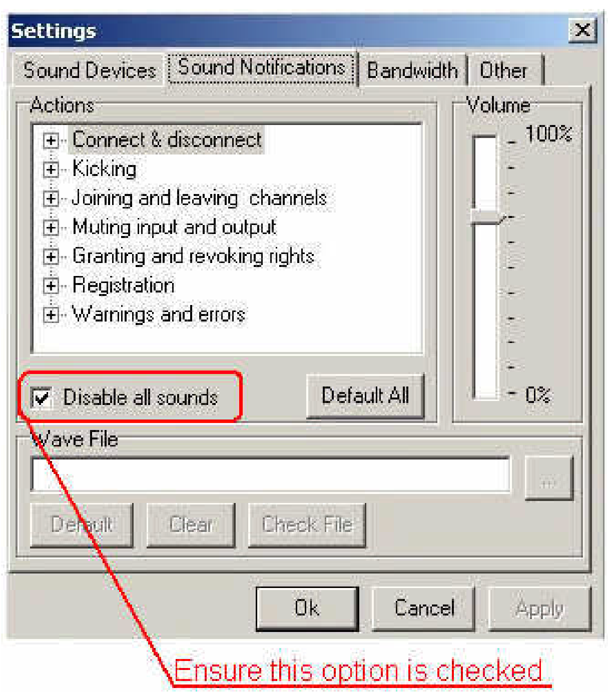




One note about the Voice Send Method, you'll notice that there is a voice activation selection. It is not recommended you use this method during ATC sessions but rather the PTT method. If you use the TeamSpeak channels for other than an ATC session such as to merely converse with others then this method would be fine. You should now be setup to a point where communications are possible.

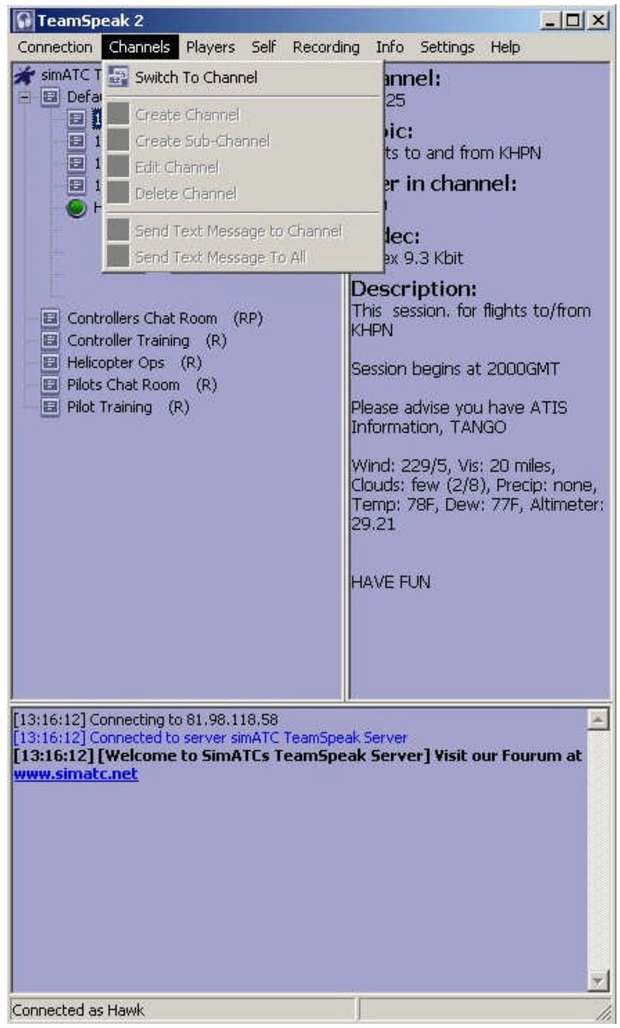
Step 3. TeamSpeak has an options menu as shown below on the left that we need to make one change in the Sound Notifications section shown below on the right. Make sure the Disable all Sounds option is checked. You'll find that for our purposes most of these can be annoying.





TEAMSPEAK BASIC OPERATIONS

Now I'll review quickly some operating points. If you want to tell everyone you're not available for the moment then click Self and then click Away as seen in the screenshot below on the left. Also just under this selection is a selection to mute your microphone. This will still allow you to hear conversations but block your microphone audio from being transmitted to others.



When more than one channel is available within TeamSpeak then there are two ways to change channels.

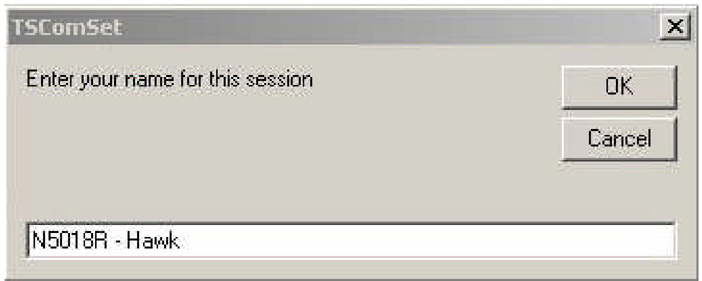
1. You can double-click on a channel (put the cursor over the frequency then double-click)

2. Highlight the channel you wish to change to then click on Channels highlighting and clicking on Switch Channels as seen in the screenshot above on the right.

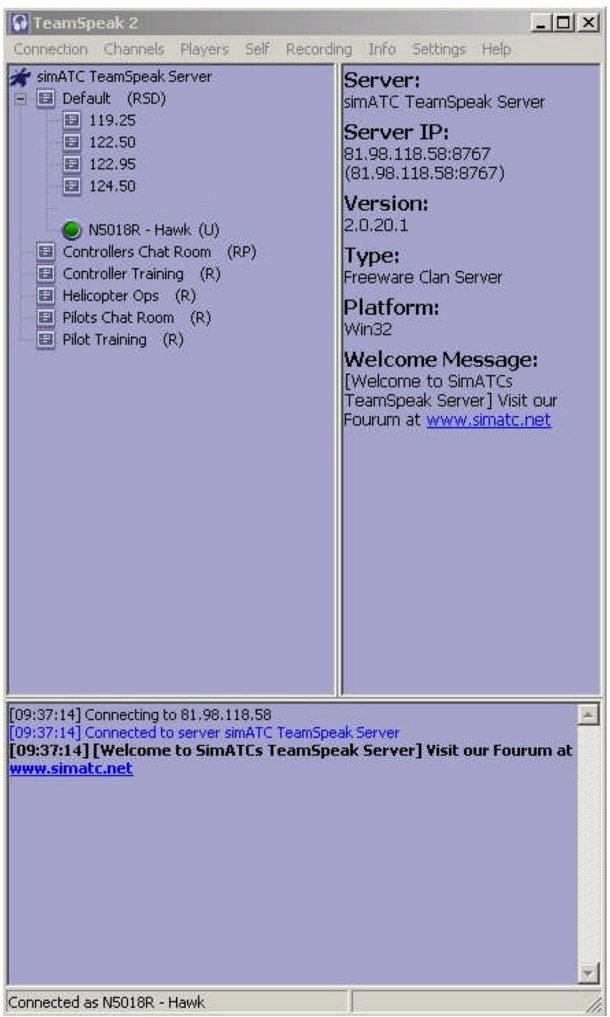
If you wish to learn more about the other capabilities of TeamSpeak then click on Help or visit the TeamSpeak web site.

TSCOMSET

There is one utility made to work with TeamSpeak I'll discuss now that is very important from the pilot perspective. That utility is called TSComSet and provides a means for pilots to change the channels from within their aircraft using the cockpit radio panel instead of having to do it as described above. This provides a much better experience during "live" activities. After proper installation all you have to do to use TSComSet is start your flight simulator and get into your selected cockpit. Then start TSComSet which will display the window below. Enter the aircraft identification and optionally your name then click OK.

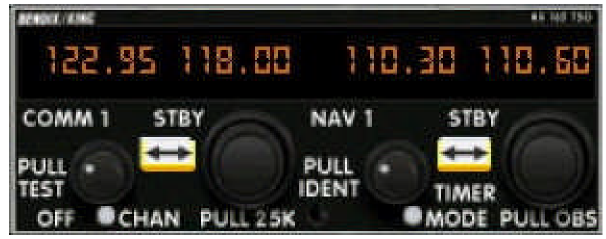


You don’t even have to start TeamSpeak because TSComSet will do it for you while connecting to the cockpit radios. You’ll be automatically placed in the channel that the COM1 radio is tuned to in the cockpit radio panel. If the frequency set in your COM1 radio is not available in TeamSpeak then you’ll end up in the default channel as seen on the left below.



The default channel will be assigned a frequency even though not shown (only the Default label is shown). In the case of our SimATC server the default channel is set to 118.0 (the lowest tunable voice frequency available). Even though it looks like you may be in the channel for 124.50 as seen above left this is not the case. Your label will shift (indent) slightly to the right when entering established channels as seen above right.

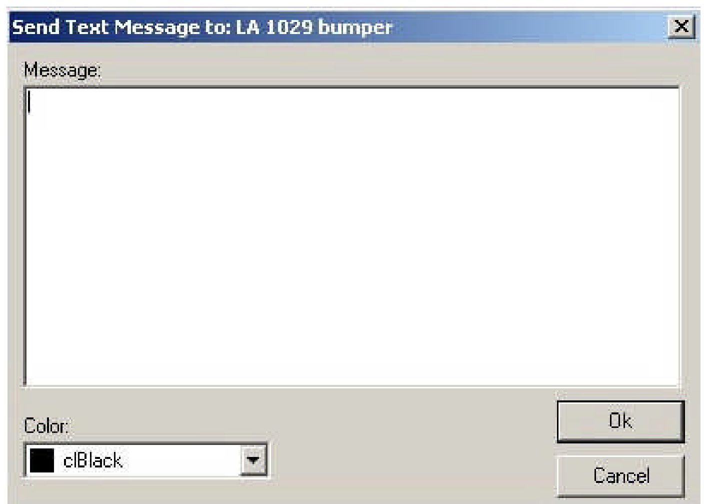
Any time there is an error during frequency selection you'll end up in the default channel shown in the above left screenshot. Take a look at this example where the frequency 119.22 is improperly tuned below left. As seen in the frequencies above there is no 119.22 channel so you would end up going into the default channel as shown above left just as if you had tuned 118.00. But if you retune to an available channel such as 122.95 below right then you'll end up in the channel as seen above right. When switching channels be patient as it takes a second or two for TSComSet to get it done.



TEAMSPEAK TEXT MESSAGING

There is a text messaging window located at the bottom within the TeamSpeak window. There you can see messages from the TeamSpeak server itself and from players connected via the TeamSpeak server. This window can at times come in handy such as when experiencing problems with a microphone to get quick messages across to others.

To send a message via TeamSpeak to another player just highlight the players label then select Players and highlight and click on Send Text Message to Player as shown below on the left. A window as shown below on the right will pop up allowing you to type your message, just click OK when finished and the message will be sent to the highlighted player and displayed in their message window at the bottom of TeamSpeak.



FS NAVIGATOR

What do the controllers use for the scope? A program originally designed as a flight planning tool for pilots called FS Navigator http://www.fsnavigator.com/index.htm (payware) by Helge Schroeder and though not designed for ATC use, lacking specific functionality and tools for controllers, it can still provide the ATC essentials when connected to FSHost. Because the controllers use FS Navigator it is highly recommended pilots continue to use it as an excellent flight planning tool. This way everyone is playing from the same "sheet of music" <grin>. Within this section I'll discuss the basic settings and help you understand the features in FS Navigator. Later in the manual I'll explore the exact methods of using FS Navigator from either the pilot or controller perspective.

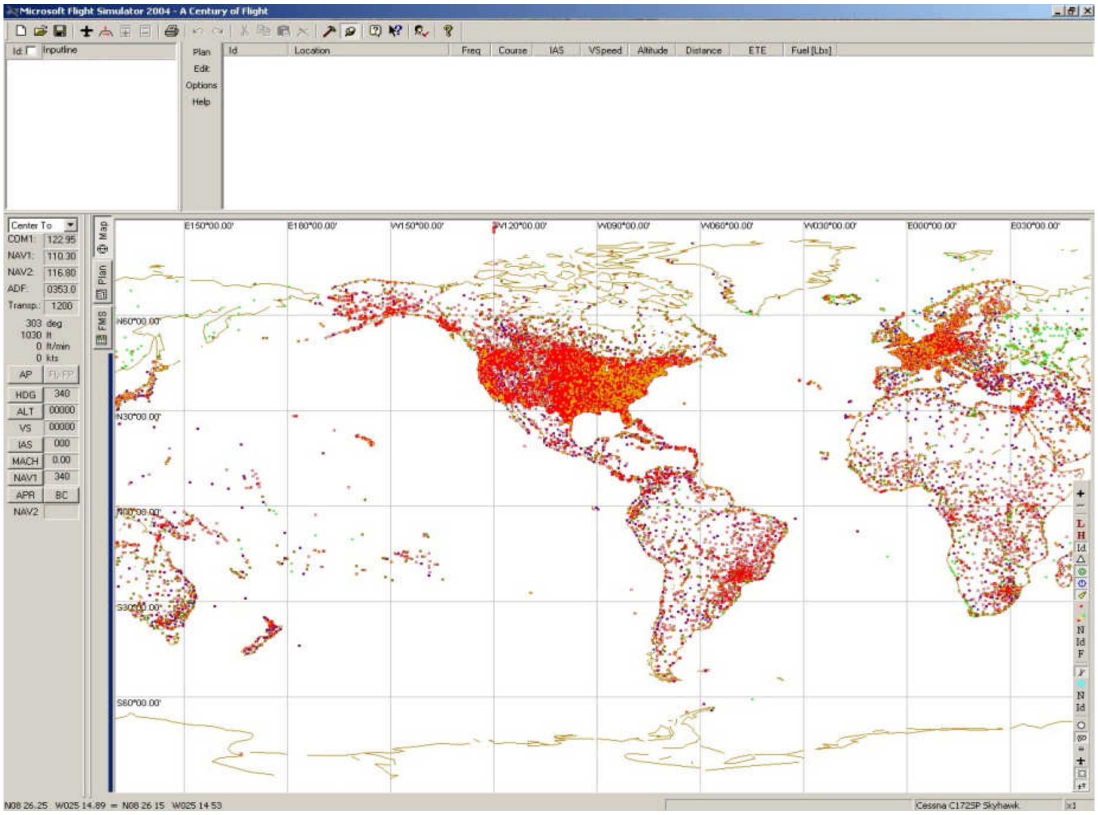


Figure 12 - FS Navigator main screen/map.

SETTING UP FS NAVIGATOR

Once FS Navigator is installed you'll need to do some basic configurations. So click on OPTIONS then SETTINGS as shown below.

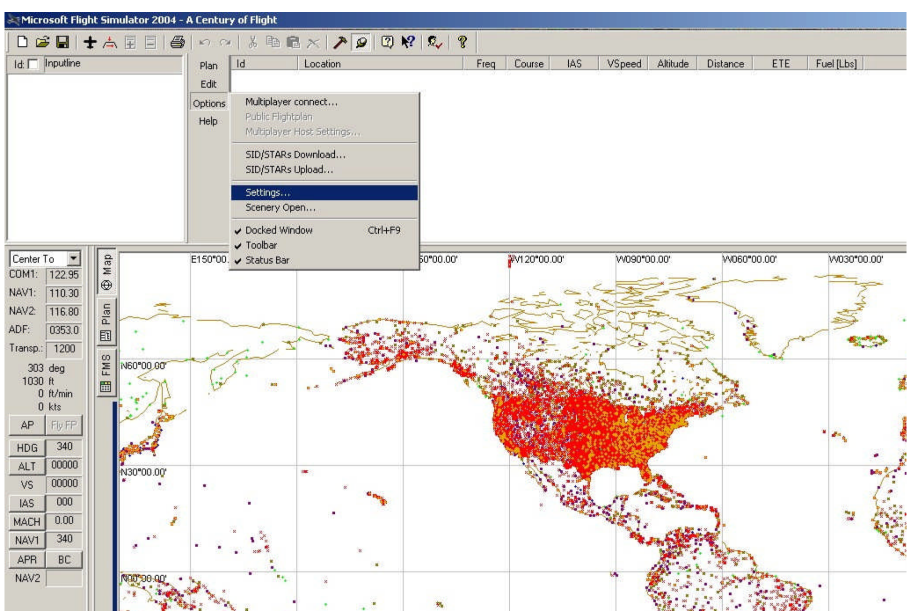
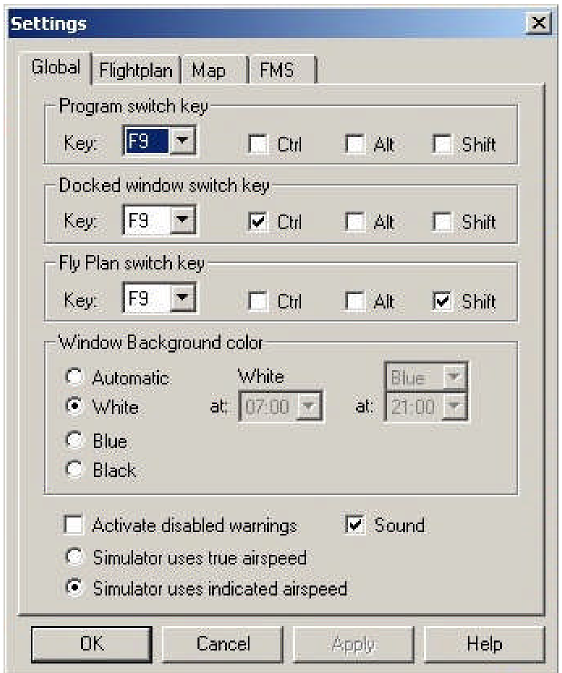
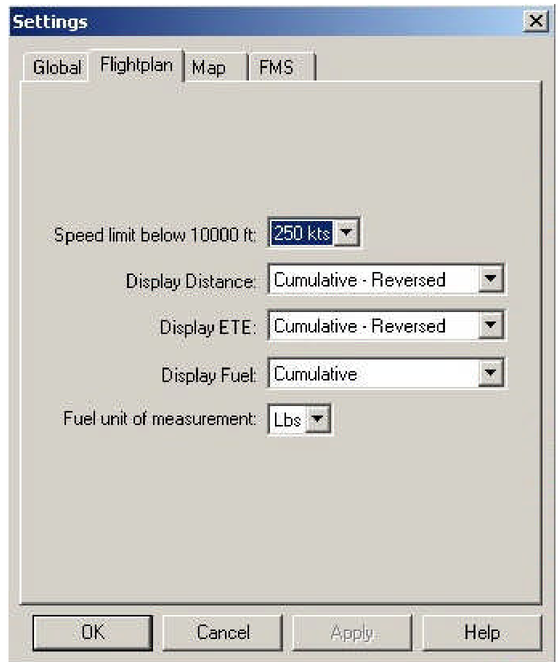


Figure 13 – FS Navigator Options>Settings.

You'll then see the window for the Global tab as shown below left. Here you can set the hotkeys used to display FS Navigator within the flight simulator (Program Switch Key), the hotkey to dock or undock FS Navigator (Docked Window Switch Key), or the hotkey to link flight simulator to FS

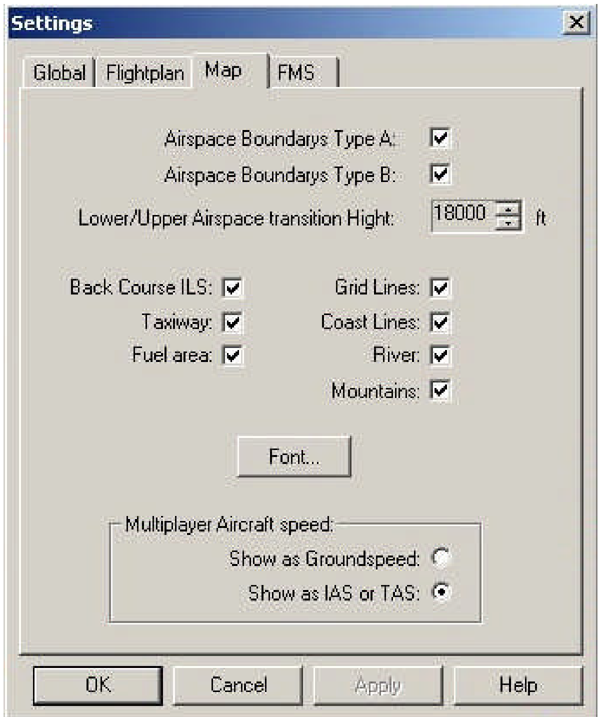
Navigator for autopilot purposes (Fly Plan Switch Key). These are best left at the defaults for now. The Window background setting is a matter of preference. During ATC online play my room is typically dimmed (just like most ATC centers to cut down on glare) so I leave mine on Black. For the purposes of this manual I changed it to white to conserve black ink during printing, your choice. Always check "Simulator uses indicated airspeed". That way the airspeed shown on the FS Navigator map will match what the pilot sees on the cockpit airspeed indicator.

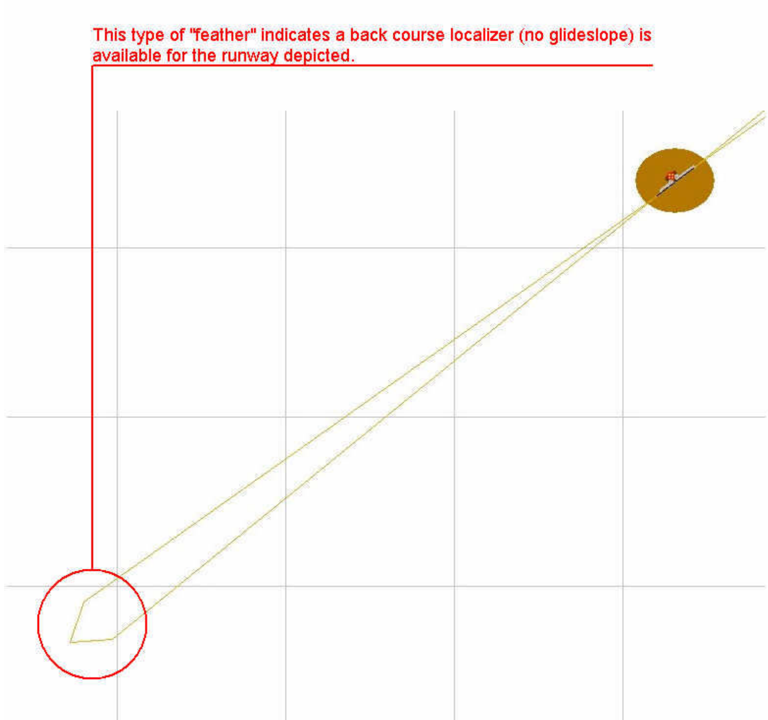




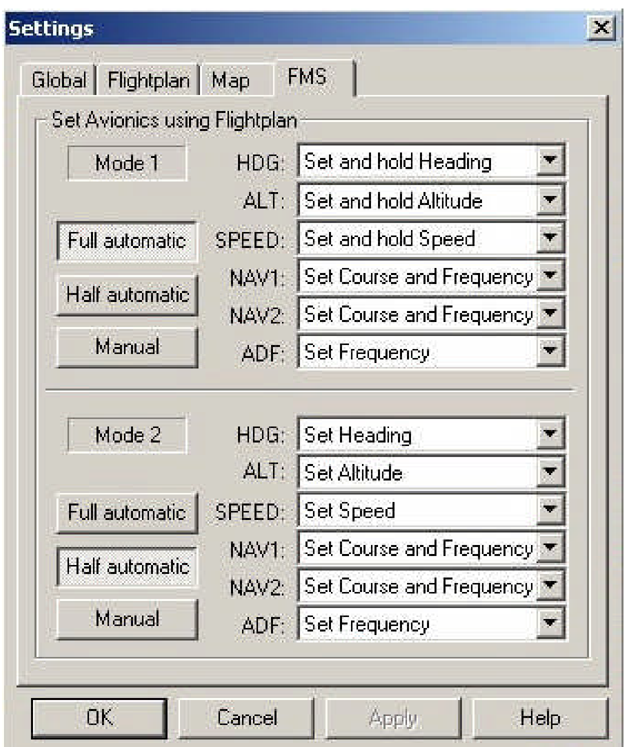
Now click on the Flightplan tab as shown above on the right. As you progress through this manual you'll find out that any aircraft flying below 10,000 feet is restricted to airspeeds not to exceed 250 knots unless otherwise advised by ATC. In regions where ICAO flight standards are used (such as in Europe) pilots may be allowed to exceed this limit on a regular basis but for the purposes of this manual we'll stick to the U.S. FAR/AIM so set this to 250 knots. The next two items, Display Distance and Display ETE (Estimated Time En route) are shown set to "Cumulative – Reversed", again a matter of preference, I like mine to "count down" the mileage as a flight progresses. Select the one that best suits you. Display Fuel is done in the same fashion, per preference. The "Fuel Unit of Measurement" in this case is set for pounds per gallon. Depending on your use and method of calculating fuel you can set it for pounds, gallons, liters, or kilograms.

Next click on the tab labeled Map as shown below left. Make sure both "Airspace Boundaries A and B" blocks are checked. In the "Lower/Upper Airspace Transition Height" enter 18,000 feet (again later in the manual you'll learn the specifics as to why 18,000 feet is the transition height. The next checkboxes, Back Course ILS, Taxiway, Fuel Area, Grid Lines, Coast Lines, River, and Mountains should all be checked. I only make one exception to this rule. Depending on the experience of a user you may want to uncheck "Back Course ILS" so these type approaches are not depicted on the FS Navigator map (done by showing what we call a "feather" with a tail that looks like an arrow shown below right. If you finish this manual you will learn how to conduct a back course ILS without any problems so for now leave it checked.





Next click on the FMS (Flight Management System) tab as shown below. The options on this tab are primarily used from the pilot perspective for control of the simulator during a flight. For now leave them at the default settings and we'll go over these in detail when discussing the use of FS Navigator from the pilot perspective.



CONNECTING FS NAVIGATOR TO A HOST

Step 1. To connect FS Navigator to FSHost you must open the "Multiplayer connect" window (shown in figure 16 below) using the Options menu as seen below in figure 14.

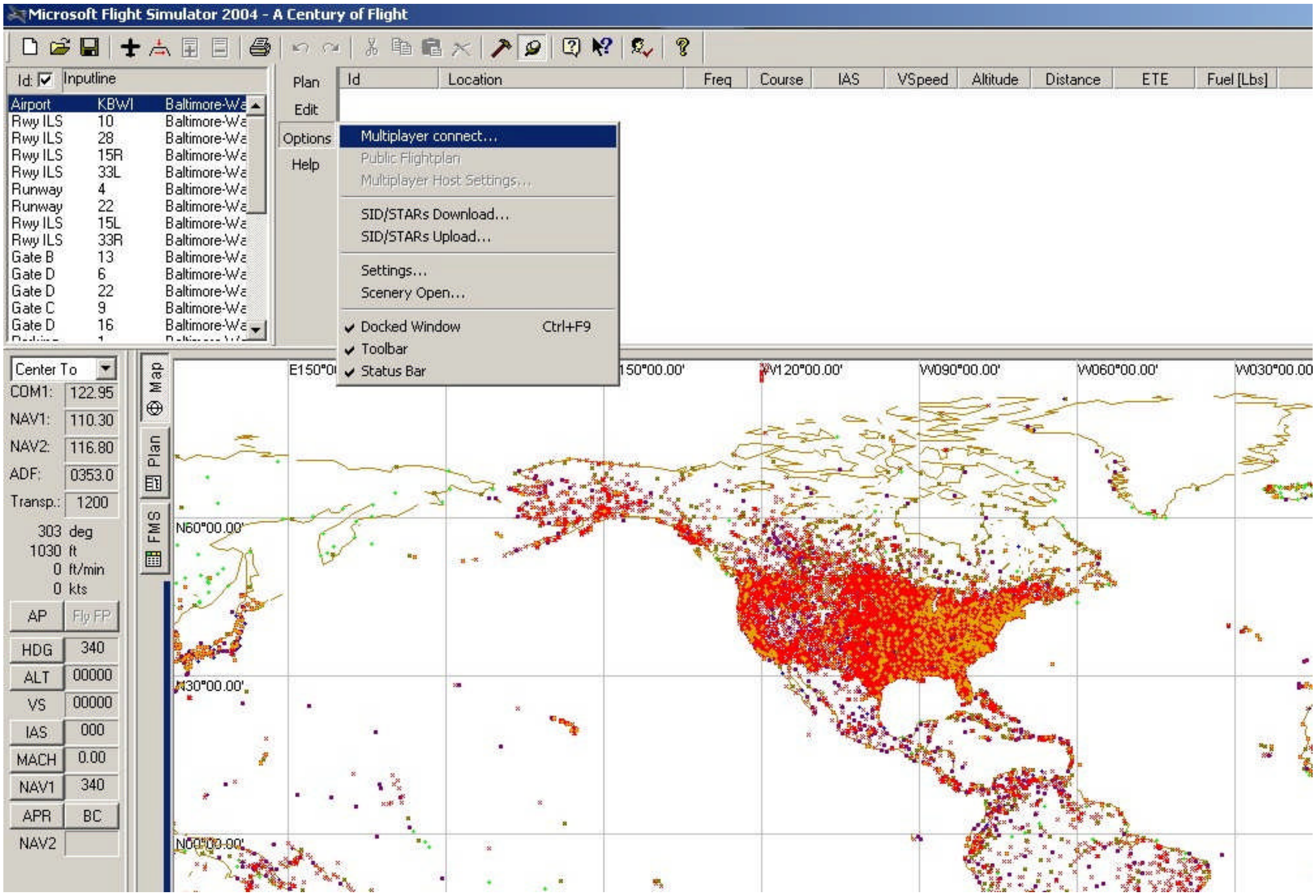


Figure 14 - FS Navigator Options>Multiplayer Connect.

When you click "Multiplayer connect" you will see a warning pop up (see figure 15 below) to ensure the flight simulator is in "Window Mode" (not full screen mode) before connecting via a dial-up connection. If you have a 24/7 broadband cable connection, then check the box that says "Do Not Show Again" and then click YES to continue.

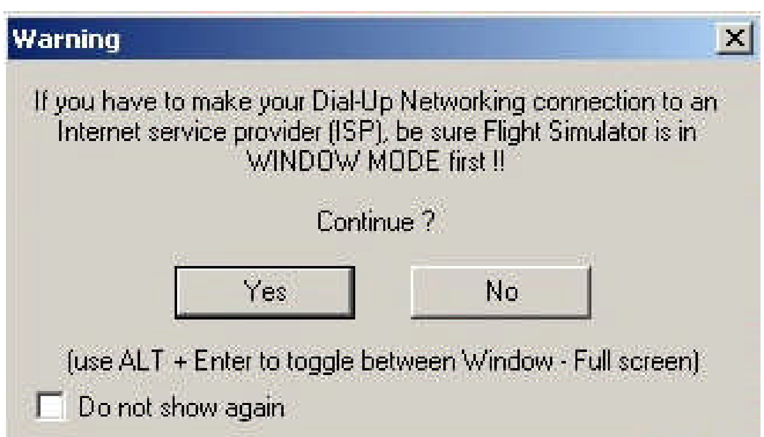


Figure 15 - WINDOW MODE Warning during a dial-up connection.

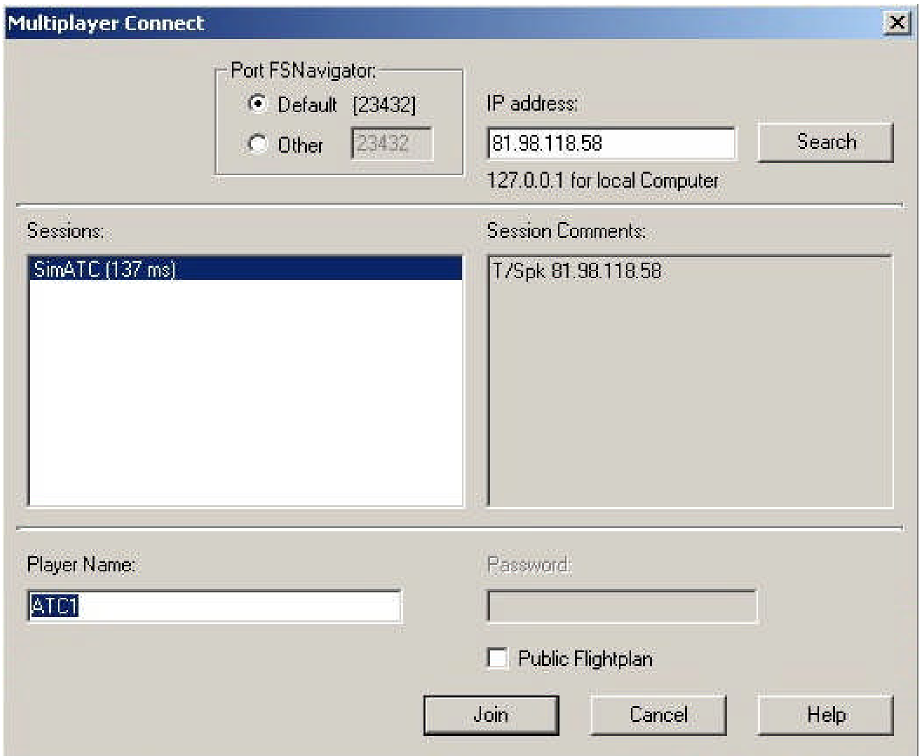


Figure 16 - Multiplayer Connect Window

Step 2. The "Port FS Navigator" setting must be different from the port number you use for your flight simulator as seen below in figure 17. The default of 23432 in figure 16 above should be sufficient unless a conflict exists with a port in figure 17 below, in that case select "Other" (in figure 16 above) and type in a port number that does not conflict.

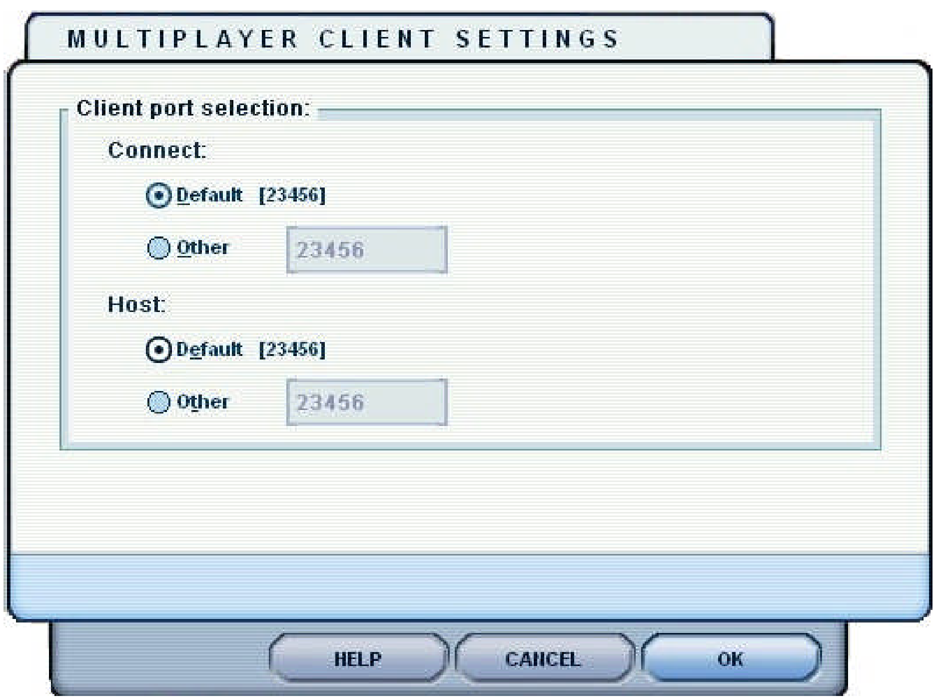


Figure 17 - FS9 Multiplayer Client Settings

Step 3. Enter the IP address of the host computer and click SEARCH. If your local computer is the host, then enter 127.0.0.1 for the IP address and click SEARCH. FS Navigator should now find the host (within a matter of seconds) if everything is okay and display the session name with a latency time shown. Typically there will only be one session found but if there is more than one be sure to select the proper session to join (example, there may be other sessions at the same IP address for things like air races and such and the session name should describe each session). If the administrator has entered any special notes about a session they will display in the session comments for the session highlighted.

Step 4. Enter the name you wish to be seen as in the session. It is typical to enter the same name you are using in your flight simulator connection so administrators will know who is connected via FS Navigator. For instance, you log into FSHost with your flight simulator using the name N5018R, this now would be the preferred player name for connecting with FS Navigator. Follow the guidelines for entering names provided by your ATC service. Some ATC services will set FSHost to block FS Navigator connections accept for their controllers just because of the bandwidth issue so do not connect using FS Navigator unless the service approves. Once you enter your name click JOIN. Note that it can take up to 30 seconds after clicking JOIN until connection with all other participants has been established. Only then can you see all the other aircraft on the map.

That’s it! The only indication that you will get that you are truly connected will be the fact that you see the other aircraft show up on the display map depending on their location(s). Also the “Multiplayer connect” will now change to show “Multiplayer Disconnect” as seen below in figure 18.

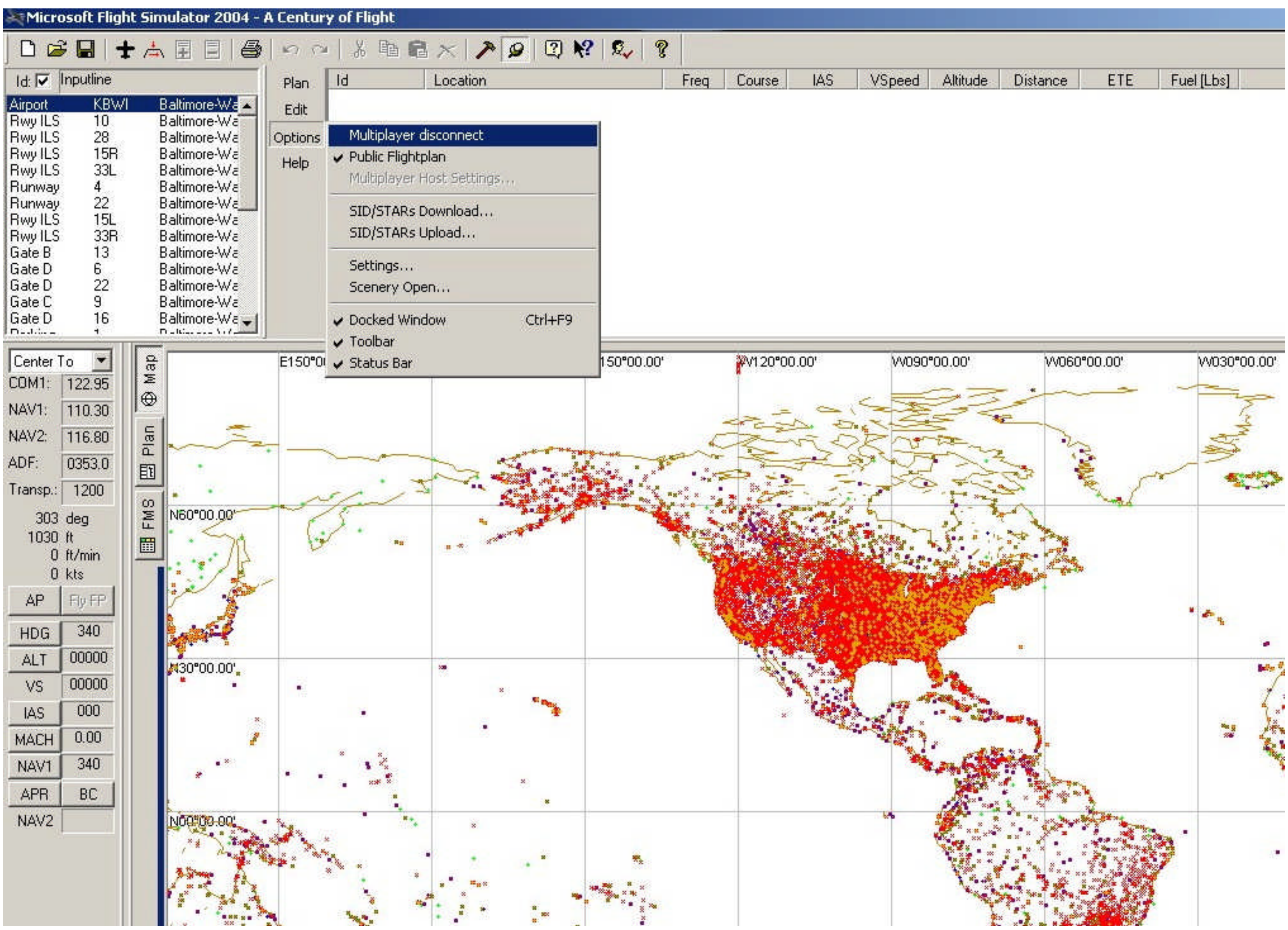


Figure 18 - FS Navigator Options>Multiplayer Disconnect.

Aircraft are depicted on the map by a small green symbol as seen below in figure 19.

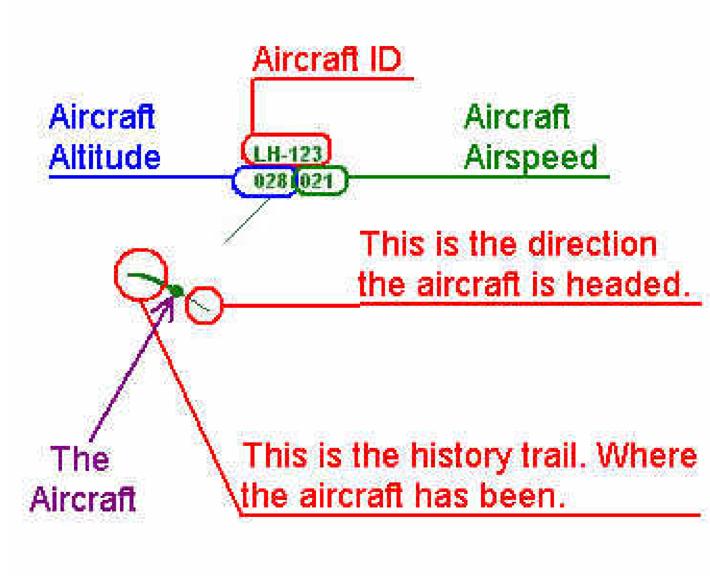


Figure 19 - FS Navigator Aircraft Blip

Again, I'll summarize the use of FS Navigator from the pilot and controller perspectives in the various chapters to follow as they each have unique methods of using FS Navigator for the intended purpose.

OTHER PROGRAMS

Here in this section I explore using other programs that will enhance an ATC service. These programs can provide extra challenges for pilots or controllers during online activities or further support the operations by providing features not available in the primary pieces of software used to make up the ATC environment.

ATC RADAR SCREEN

There is another program named ATC Radar Screen by Manuel Ambulo that is an excellent ATC tool http://www.fsmanuel.com/viewpage.php?page_id=4. The program provides greatly enhanced taxiway views compared to FS Navigator for the online controller. Even though FS Navigator depicts taxiways they do not have details such as the taxiway identifications as the pilot would see when looking outside the cockpit. This disables the ground controller quite a bit from providing pilots exact taxi instructions. By using Manuel's program controllers can provide detailed taxi instructions.

Just as a side note, Manuel also provides a stand-alone airport charting program that provides the same airport views as his ATC Radar Screen program but more so for the pilot. This is very handy for the simulator pilot trying to follow online controller's taxi instructions.

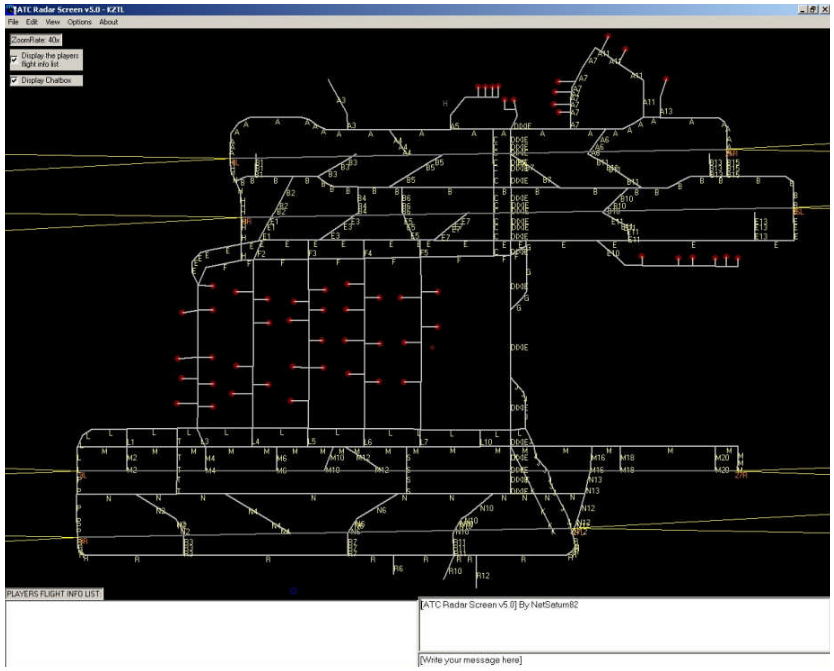


Figure 20 - ATC Radar Screen taxiway view of Atlanta Intl (KATL).

ATC Radar Screen is actually a versatile program that can, when used in conjunction with FS Navigator, fill in for other missing features required by controllers. It is capable of displaying multiple SIDs and STARs for one or more airports on the radar screen at one time (you actually install the same SID and STAR data used by FS Navigator). If a controller clicks on an airway within ATC Radar Screen it provides minimum en route altitudes (MEAs) for aircraft, another great feature not available in FS Navigator. The developer states that the new version will allow for the use of things such as the squawk codes not available in FS Navigator and will be a self contained client-side and hosting application for online ATC use.

The drawbacks (and I'm hoping like many that these will be improved in the new version) are that sometimes its use is not so intuitive. What I mean to say is sometimes it is difficult to get things to work the way a controller works (the motto, make it work the way controllers work). For example, in the current version when an aircraft is approaching the destination airport, it is difficult to determine where to start the descent into the airport because it is not easy to identify and judge the distance to the arrival airport from the aircraft's current location. This is typically done in FS Navigator by creating a "cheat" or way to see the flight route. In ATC Radar Screen there is no way to show a flight route for an individual aircraft, or display airport identifiers when zoomed out on the map (typically when zoomed out the airports are shown as nothing more than small X's (this is probably to keep the screen clutter under control). To see airport identities the controller is forced to zoom in up close but typically the aircraft is still quite a distance from the airport, enough so that the airport identifiers can not be seen by zooming up close (they are still a bunch of "dots" on the screen) making it impossible to identify the destination airport easily and "measure" the distance between the aircraft and destination airport. The best answer to the problem is to be able to display an individual flight plan on the fly, this would allow the controller to "see" the aircraft's flight route very easily and make operational judgments such as arrival descents. The controller needs information displayed easily and readily as required, making its use intuitive <grin>.

If the new version brings the best features of all the various applications available today into one neat package and provides the controllers new tools to manage aircraft then ATC Radar Screen will most likely be a fantastic hit among virtual controllers. According to the developer this program is receiving a major overhaul and states the program is nearing the final stages for release at the time of writing this manual. He goes on to say that it will be available to the general flight simulator community and will embody improvements that will make it comparable to the software in use by VATSIM (about time <grin>!) so this little package may become the next generation online ATC software package, so keep your eye on this one, I may have to rewrite the manual <grin> and that ain't all bad as they say!

The current version of ATC Radar Screen can be connected to FSHost in a multiplayer environment in much the same manner as FS Navigator. The only drawback is this program is not made to cover the entire virtual planet such as FS Navigator can but recently with an additional patch it has been made to load *multiple* ARTCC/FIRs allowing it to cover very large regions. The worst drawback about this is you can not save preferred groups so you must reload favorite ARTCCs/FIRs during each session. You also must select to control either an airport from a top-down perspective (tower mode) or you can select an ARTCC/FIR region(s) for control.

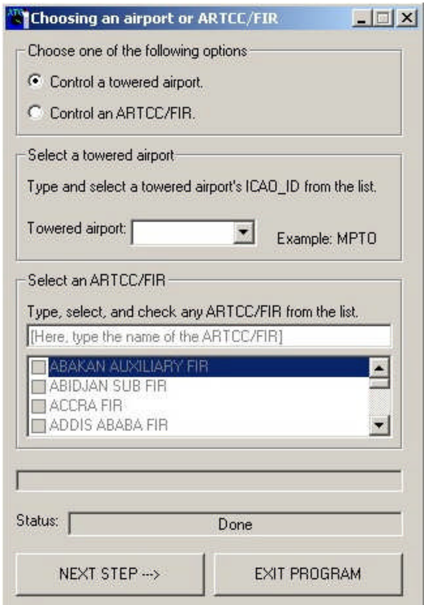


Figure 21 - Choosing an airport or ARTCC/FIR in ATC Radar Screen.

From our use we found you can do most everything in the ARTCC/FIR mode you can in the tower mode so the tower mode was not really all that important to us. Another factor in the use of ATC Radar Screen is how you use it, what I mean is your use based on the operational methods you employ. It can be perfect when using it via a single controller per sector(s) or tower mode setting (much like a VATSIM session) but our operational methods don't work like that as our controllers use methods to allow them to act in any controller position, at any time, any where on the virtual planet. This is a method you'll learn about in chapter 2. Still the most current version is versatile enough to provide our methods some great features compared to FS Navigator. So, we typically use it as a secondary online scope (such as for the airport taxiway details) to supplement FS Navigator (but as discussed this may soon change, keep those fingers crossed). Smaller groups can use this program well (and in conjunction with the new FSX tower cab provides many possibilities and coverage) such as using the multiple ARTCC/FIR feature (see figure 22 below) and congregating controllers in adjacent ARTCC sectors they can cover a very large region (thousands of miles) providing good flights. Just a few controllers can handle the entire USA or Europe.

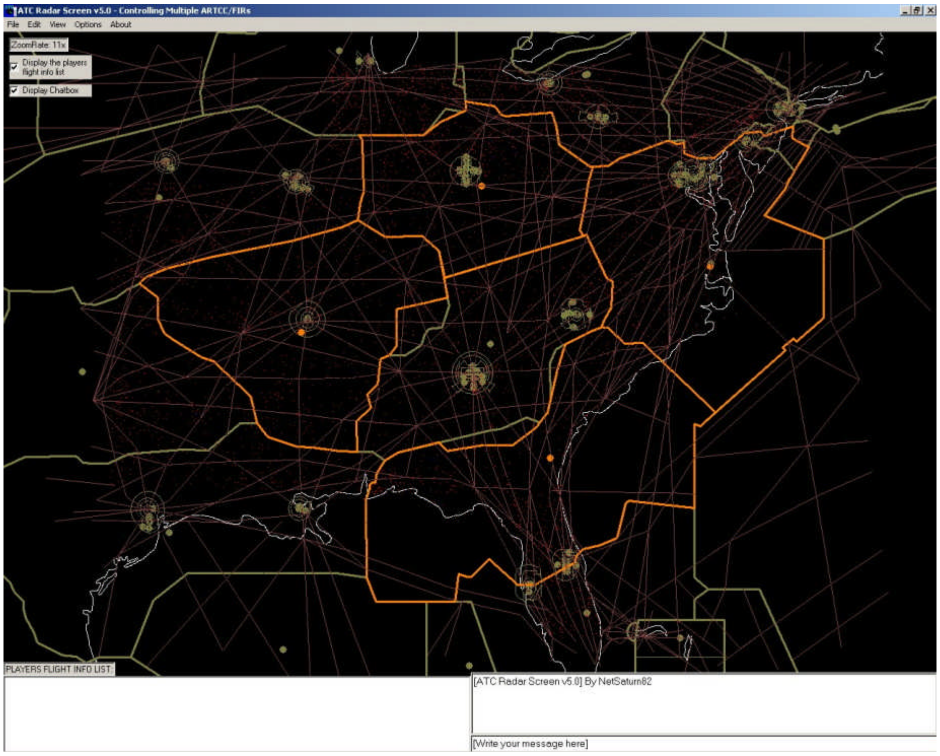


Figure 22 - Multiple ARTCC sectors loaded around the Atlanta ARTCC (Orange boundaries).

vPAR

A *very special enhancement* for an ATC service is the ability for a controller to provide a means to "talk" a pilot through a precision approach (the same as an ILS approach). In the real-world these approaches are called *Ground Controlled Approaches (GCA)* using a *Precision Approach Radar (PAR)* simulated here by a program called vPAR http://bathursted.ccnb.nb.ca/vatcan/fir/vPAR/ by Michael Oxner.

PAR is designed to be a *landing aid* rather than for *sequencing and spacing* aircraft. PAR can be used as a *primary landing aid* **or** *to monitor other types of approach* such as ILS, VOR, NDB, and GPS. It is designed to display range (distance), azimuth (path) and elevation (altitude) information. Each scope (*actually two scopes in one*) are one on top of the other divided horizontally as shown below in figure 23, the top half of the scope providing a view of the *altitude and distance* information and the bottom scope providing a view of the *path and distance* information.

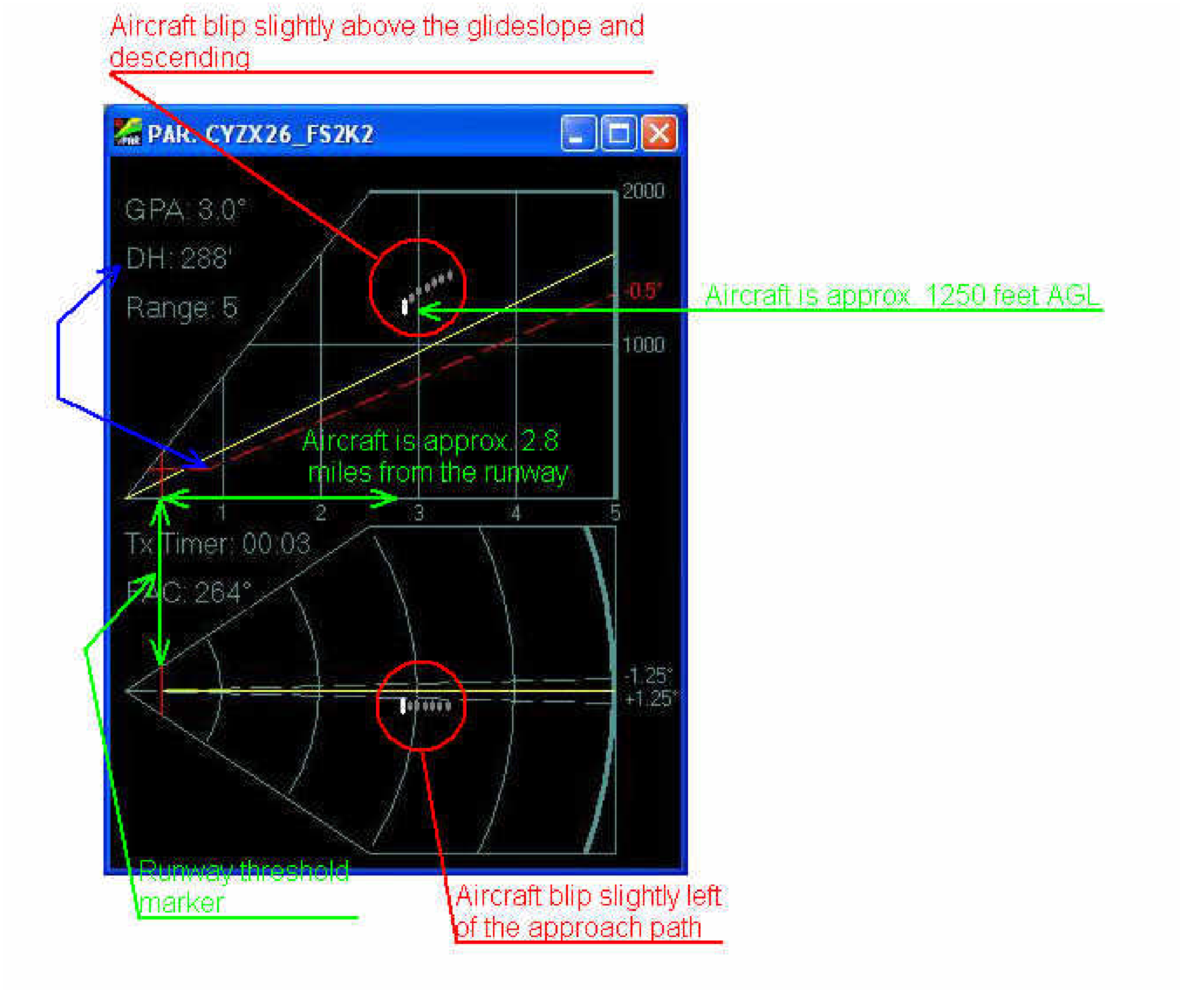


Figure 23 - A view of the vPAR scope.

The vPAR scope works via information sent from a small client-side application installed on the pilot's computer (very easy installation and setup). The developer states this was done due to the inherent short comings of the flight simulator to properly send data in real-time fashion to enable the proper updates to the PAR scope, the PAR scope must be updated very quickly for the Ground Control Approach (GCA) controller to see changes in the aircraft path and altitude in a real-time fashion and relay this information via voice to the pilot else the pilot would not receive accurate updates as to the approach from the GCA controller and the approach would quickly go bad.

To understand a PAR approach in a nutshell, imagine a cockpit where there is no VOR gauge with ILS capable needles to follow an ILS radio beam to the runway or the airport lacks an ILS approach altogether. The pilot advises gas is dangerously low and an immediate landing is required now but the weather is socked in with visibility at ¼ mile. The controller advises the airport does have a PAR approach the pilot can conduct to make a safe landing. So the approach controller vectors the pilot to the correct position to start the PAR approach to the runway and hands off the pilot to the specially trained GCA controller that will be using the PAR scope. The pilot readies the aircraft configuration for landing and the GCA controller advises no further response is required (meaning the pilot only "listens" to the GCA controllers information) so as to make proper corrections in the approach path and vertical descent rate. The controller starts continuously telling the pilot if the aircraft is on the approach path (left or right of center) and whether on the glide slope (above or below the glide slope) doing the same thing the pilot would if they were watching the ILS needle deviations to correct for errors in the approach until reaching the runway threshold. The controller basically "talks" the pilot down the glide slope and approach path to the runway threshold using special phraseology that the pilot is trained to understand and then properly react to each instruction.

Believe it or not, this type of approach can make a better ILS approach pilot out of anyone <grin>, and why, because this type approach causes the pilot to use the correct methods to perform a precision approach in most cases not normally done. What I'm saying is most pilots don't understand the correct techniques to actually fly an ILS by using proper power, angle-of-attack, vertical descent rate, and corrections to direction. Most pilots instead fly by the stick (the yoke) and end up "chasing" the needles down to the threshold. This is not the correct way and if used during a PAR will only frustrate the pilot (and controller!). Any pilot who tries their hand at this with visibility set to ¼ a mile will find out quickly just how difficult it will be without using the proper methods. In the end if you learn these methods (and I'm going to teach you these in this manual) then you will with practice find the confidence to conduct any precision approach with ease.

In figure 23 above looking at the PAR upper screen section the aircraft blip is depicted *moving down the glide slope in real-time* (as discussed the controller would be *providing information to the pilot by voice communications* as to whether the aircraft is *above, below, or dead on the glide slope)*. The upper section indicates the aircraft is above the glide slope starting to descend slightly (the tracking ticks behind the aircraft provide aircraft movement history) showing in real-time *aircraft deviations from the glide slope*.

At the same exact time in the PAR bottom screen section the aircraft blip is depicted *moving along the approach path (azimuth) in real-time* (the controller again is *providing simultaneous information to the pilot by voice communications* as to whether the aircraft is *left, right, or dead center on the approach path)*. This type approach is used to get pilots to the runway threshold in *IFR conditions with precision when no other precision approach system is available* or *when the aircraft ILS system has failed*.

WHAT ATC SOFTWARE NEEDS TODAY

Of the software discussed so far there are a few ideas for suggestions that I and others have kicked around for quite some time that if properly incorporated would bring online ATC play to new heights. It should be noted that the improvements are based on the functionality and features already available in each piece of software described herein. So it would be imperative to retain current features but then add the following enhancements discussed to achieve the overall improvements required. These ideas are presented in this manual with the hope that the individual authors can obtain sound information to make improvements that will benefit online ATC play or even available for a completely new set of applications and software designer(s). It should be noted that as a group we believe the developers have done a fantastic job designing the software freely available today that makes online ATC play what it is for the flight simulator community but the suggestions presented here are a flight simulator community cry for help to keep the improvements coming and build on the last true frontier for flight simulation, "live" online ATC.

SUGGESTIONS FOR FSHOST

One of the better ideas being used more often to extract more useful and practical data from each flight simulator by some savvy developers is a client-side application. The developer of FSHost has indicated that a client-side application may be considered for a future version. This is the same principle used by the vPAR program mentioned earlier to overcome problems with data flow to their main application (radar screen) used by controllers that flight simulator didn't handle well. Client-side applications are not new; VATSIM uses the concept in their proprietary software to achieve things like providing squawk codes from flight simulator. Manuel Ambulo has indicated version 6 of ATC Radar Screen will provide new features such as the squawk codes via a new client-side application and host package he plans to release in the near future. A client-side application can provide many enhancements and compensate for differences in flight simulator versions.

Remember the flight plan form spoke of earlier in this chapter; the form could be built into a client-side application and even made to look exactly like the FAA flight plan form itself, that once filled out the client-side application could send to the host software along with other retrieved data to improve the use of each connected flight simulator during a multiplayer session. In other words it could completely bypass flight simulator by providing a self contained method for filing flight plans on the client's computer.

The amount of data that can be retrieved from flight simulator is only limited by that already provided for in the flight simulators SDKs. Ever wonder how Peter Dowson can manipulate all those parameters within FSUIPC? The data is there for the plucking but it just needs the proper application to do the plucking (and Peter Dowson is good at plucking data <grin>).

So the primary improvement here is to make one fantastic client-side application to get the ball rolling that might allow any developer to tap into and get creative making the hottest online ATC program ever (and I mean so hot it will become the ATC program from hell <grin>!).

There are always those situations where problems for one reason or another might not be overcome but some capability has been there just not actively tapped into and the online ATC community needs help from those talented folks that can make this happen <grin>!

Another major improvement that would be very exciting within FSHost would be the ability to feed it real world weather to provide all linked flight simulator clients and even controllers stationed based real-time weather. If the information is fed to the controllers scope (this capability would have to be developed in FS Navigator) and a button made available to turn the weather display on and off then the controllers could provide weather avoidance vectors for pilots that don't have weather radar (such as the RealityXP WX500 http://www.reality-xp.com/products/WX5/index.htm) in their aircraft. In the FAQs on the FSHost site the question is asked if real-world weather is available and the answer is "At the moment, no. But I hope to add this feature some time soon." This would be the hoot of the century when it comes to online flight simulation. Station based weather provided by the hosting software would create the same environment for all connected players that is fluid and changing as Mother Nature and the virtual pilot and controller alike would be greatly challenged by such an enhancement. The trick is in managing the use of precious bandwidth.

The manual system to depict weather is great for certain cases of ATC activities. There is a utility written by Jon Finch that can be used to set various weather patterns and provide a schedule to cycle the patterns within FSHost currently providing pilot's different weather, yet it remains very predictable. So to date to achieve the best challenge for pilots during activities the controllers must manually manipulate the weather settings within FSHost during live activities, cumbersome but doable.

Another improvement suggested to the author was to bring back the ability to monitor latency in data connections. This was not done in times past due to technical difficulties but recently the developer has indicated the problem has been overcome for all three versions of flight simulator (FS2002, 2004, and FSX). This will allow administrators the ability to possibly filter out or restrict bad connections that could disrupt multiplayer activities due to poor connections. This will be a welcome feature to have back.

SUGGESTIONS FOR TEAMSPEAK

Our controllers after using TeamSpeak for years now have had a growing wish list for specific enhancements that would aid the communications for controllers and pilots alike. To date I have tried to contact TeamSpeak to inquire about the future of the software but have never received a reply. The shame about this is that new TeamSpeak enhancements would no doubt make major improvements in enhancing online ATC activities as you'll see here. Even though TeamSpeak is used in many communications environments it certainly has many users within the flight simulator community and it would be nice if the TeamSpeak folks would help provide some enhancements.

One of the channel enhancements that would be nice to see developed for the TeamSpeak client for those that have R/CA/SA authority (typically that is the controllers) would be the ability to attach a recorded .wav and/or .mp3 file to constantly play on a selected channel to simulate ATIS broadcasts. Pilots could switch to this channel and receive specific weather information or "Notices to Airman" (NOTAMs). A simple window to navigate to the .wav or .mp3 file to be selected that was produced using a simple audio recording program and a check box to either activate or deactivate it once selected would do very nicely.

Another major channel enhancement concerns the indicators for in-channel communications, PTT, and the whisper block. Within Teamspeak there is a feature called Channel Commander. When properly used by those that are controllers on TeamSpeak it provides for "background" communications that the pilots are not privy too (just as controllers coordinate in the ATC centers in real-life) but there is a situation, where when a single controller gets busy talking to pilots in their own channel it can be very frustrating when another controller tries to speak to them directly or the other controllers start talking to each other causing "back channel" chatter. There is a provision to help this and it is called the "Whisper Block" used to mute incoming audio from other controllers on the back channel. The problem with using this feature is once you mute the audio the controller may get busy and forget about it because there is no "up in your face" indication you have the feature turned on causing problems for the other controllers at critical moments trying to contact the muted controller. There is a way to tell when the whisper block is being used by highlighting any TeamSpeak user and looking at the player attributes on the right hand window pane of the main TeamSpeak screen where it will tell if the whisper block is turned on but there's an old saying "out of sight out of mind", what more can I say. So what is required is a new "up in your face" indicator system and I'll describe it shortly but before I do we must discuss one other problem that also needs a new indicator.

When a controller is talking to or listening to a pilot in-channel there is no indication to reflect this to the other controllers in other channels. In other words if I were controlling in a channel I'll see the indicators keyed by those users in my channel, I'll also see when other controllers are keyed using the Channel Commander Mode, but I can not see when users in *their* channel are keyed up talking to them. So if another controller is busy listening to a pilot I can still "step" on the conversion because I have no indication the controller is listening to a pilot. So it would be great to have an indicator to tell if any user in another controller's channel is speaking but without actually *hearing* the communication (in other words via a visual indicator). This would tell me the other controller is listening to a user in-channel. Currently when a controller starts talking on the back channel we typically must say "hold on" to tell other controllers to remain quiet until a pilot/controller communication can be completed. When it is really busy even that disturbance can cause chaos. Cross communications will still occur regardless because the pilots will never know when controllers are passing information in the back channel but the indicators will make this more manageable.

So, the "light" indicators are the key to making this all work better. This is our suggestion to correct this situation and make it the "best" yet. Currently there is only the single round light indicator that is either dark green indicating not keyed or bright green indicating keyed for normal user communications. If the Channel Commander Mode is turned on (used primarily by controllers) then the indicator turns dark red indicating not keyed and then bright red for keyed.

So, if the light indicator for each user could be split into two sections then maybe it could be made to work as follows and solve the problems described above.

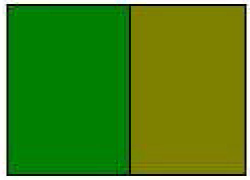


Figure 24 - The suggested basic TeamSpeak light indicators.

1. Have the first half indicate as it does now, dark green to indicate not keyed and bright green to indicate keyed by normal users (see figure 25). The trick here is to *allow those with R/CA/SA authority (or basically controllers) either using Channel Commander Mode or not, see the bright green key indication at any time across all channels.* This way the controllers will know when pilots are speaking in another channel besides their own. Regular users would only see the key indications of other users in the same channel.

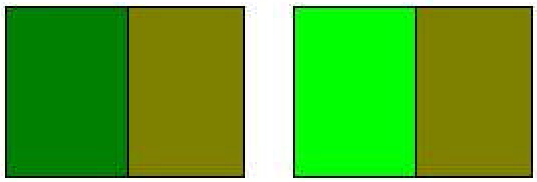


Figure 25 - Normal User Unkeyed and Keyed.

2. Have the first half change to dark red for those switching to the Channel Commander Mode (those with R/CA/SA authority like controllers) as is now available. Dark red indicates not keyed and bright red indicating keyed (see figure 26). This indicator *would be seen by any controller in any channel* and *only by users in the same channel as the controller*, but *not* by other users in another channel.

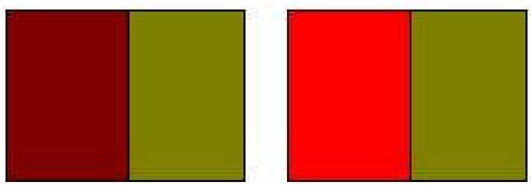


Figure 26 - Channel Commander Unkeyed and Keyed.

3. Whether using the Channel Commander Mode or not have the second half indicate the activation of the whisper block. Say dark yellow for deactivated and bright yellow for activated (see figure 27).

   When those with R/CA/SA authority (again the controllers) are using the Channel Commander Mode *allow controllers to see the whisper block across channels (any other controller can see the whisper activation)* but *do not allow normal users to see the indicator*.

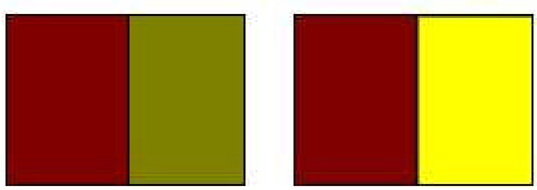


Figure 27 - Channel Commander Whisper Block Inactivated and Activated

When a normal user has the whisper block activated *allow other users, even across channels to see the whisper block* because normal users can setup a whisper to others across channels (see figure 28).

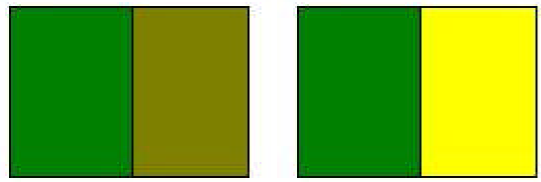


Figure 28 - Normal User Whisper Block Inactivated and Activated.

One last note about the whisper block, if a controller has the whisper block activated there needs to be a way to quietly (not by audio means) to tell the controller that someone needs to speak with them urgently. Say turn the bright yellow indicator to a *bright blue* (no dark blue is required in this case) indicating to the controller with the activated whisper block that one of the other controllers urgently needs to speak with them and they need to turn the whisper block off (see figure 29).

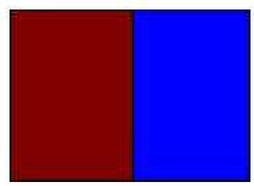


Figure 29 - Channel Commander Alert

These few indicator enhancements would be an incredible help to the controller teams that might use TeamSpeak in the future.

There is currently a utility called TSComSet written by Jon Finch that is used to allow pilots to change their radio frequencies in the cockpit. There is currently a small bug in the program that prevents the use of all 720 voice frequencies available when tuning a cockpit radio (200 are currently usable) and in discussions with the author has indicated a fix is forth coming. It would be great to build into the TeamSpeak client the ability to handle this in the same package. This really increases the realism of working the radios in the cockpit, without it the pilot must manually switch to the required frequency by double-clicking on the new frequency or by highlighting a frequency and selecting the "Switch Channel" feature in the appropriate pull down menu on the TeamSpeak client interface. The controllers can do it also using a drag and drop method.

There is also another utility called TSNoise available to produce simulated squelch noise when releasing the PTT button. It provides background noises such as turboprop engine sounds heard while listening to a pilot talking that might be flying an aircraft with those type engines. If you use TeamSpeak as is, by default the audio will usually be crisp and clear (depending on the codec selected for use on each channel). It would be more realistic to hear something like a squelch break as heard on an actual radio transmission. It would be great if this feature were also built into TeamSpeak as suggested for TSComSet above. If pilots and controllers could choose from a selection of possible background noises to simulate a piston or turboprop aircraft or no engine sound at all and just the squelch noise (for controllers), or both together then it would make the simulation much more realistic (as available in TSNoise). By incorporating it into the TeamSpeak client the pilot or controller wouldn't need to have so many different programs running at the same time. Making it where anyone can produce individual sounds (using the .wav or .mp3 formats like suggested for the ATIS capability) and allow them to drop them into a designated folder where the program could automatically locate them and allow the user to select one as required, what a grand addition this would be!

SUGGESTIONS FOR FSNAVIGATOR
Used with FSHost this program has been the mainstay for controllers as the radar scope. There are several drawbacks though, from a controller's perspective. Remember controllers using our methods can be handling any controller position at any one time so they must have access to all controller position functions at any time within FS Navigator. In other words a controller using FS Navigator as their scope (using the methods to be discussed in chapter 2) must be able to use FS Navigator as a clearance delivery, ground, tower, departure, center, or approach controller at any given moment (the methods used in this manual are not based on one single controller position or sector).

This is highly important to allow the unique relationship between TeamSpeak and FS Navigator to provide a means to conduct the operations to be discussed in chapter 2. So let me continue to examine the FS Navigator suggestions for improvement as related to the *controller's* perspective. Keep in mind, as mentioned; these features should not be restricted to any one controller position by way of applied programming (coding), but rather left versatile and flexible in use. I discuss the suggested features below by single controller positions only for clarity.

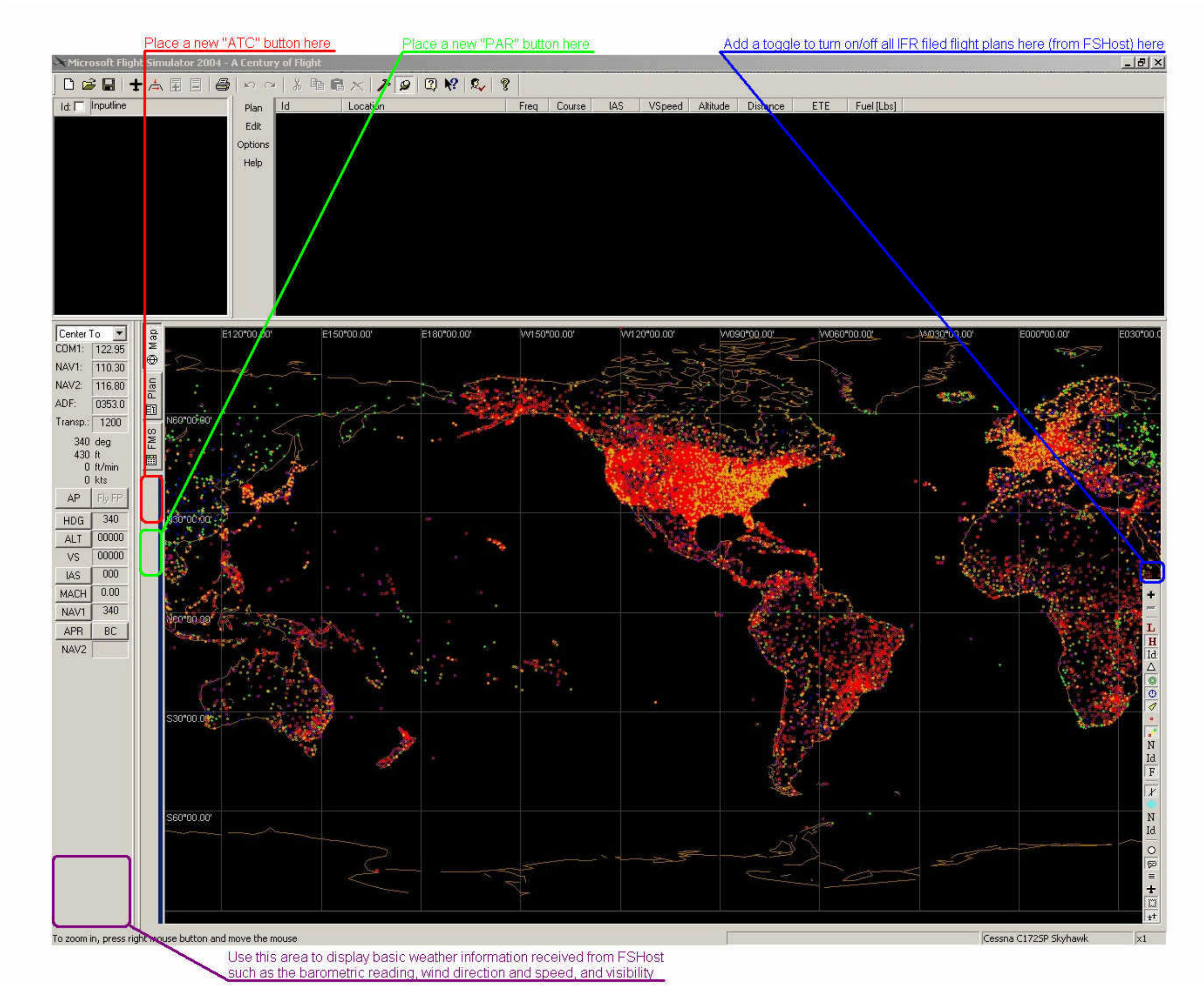


Figure 30 - The FS Navigator main screen.

Clearance Delivery (or the Ground Controller) – This controller is primarily concerned with issuing approved flight plans to the departing pilot. VFR pilots may file a flight plan but IFR pilots will always file one. FS Navigator does *not* use flight plan information from FSHost. FS Navigator by design handles only *one* flight plan that is manually entered. Typically flight plans must be manipulated and viewed by accessing FSHost via an Internet Browser by a controller using the administrator features. The manipulation of the flight plans can still be done within FSHost itself without a problem like this, but what is needed is to have the filed flight plans available to read on the FS Navigator map itself in the forms I'll discuss next.

Two separate means of looking up a flight plan are needed.

1. Where the buttons (MAP, PLAN and FMS) are at the top left of the map maybe another button could be placed below the FMS button called ATC (see the red annotation in figure 30). When this button is pressed the map view would be replaced by a window showing details about pilot flight plans brought in from FSHost. This window would contain a complete list of all active flight plans currently in FSHost. This new feature would keep controllers from having to open a separate browser window (that takes up monitor screen real estate) to read flight plans.

2. The second method required is to have the ability to point at the aircraft on the FS Navigator map and have the associated flight plan (obtained from FSHost) drawn on the map instantly. This way any flight plan for any aircraft could be displayed any time by the controller by simply pointing at the aircraft just as is done now to obtain information about airports and such. This is one of the more needed features so controllers can properly track aircraft en route per their individually filed flight plans.

3. The third suggestion is to add a toggle "switch" like those on the right hand side of the map (see the blue annotation in figure 30) that would turn on all the flight plans at one time on the FS Navigator map similar to turning on the victor or jet airways. Maybe colors could be used to distinguish each flight plan or an identifier such as used for airways.

There will be the concern about "how" to enter data into a flight plan by controllers so as to make it recognizable by FS Navigator allowing it to use the data such as to draw the flight plans on the map. Pilots will need to learn to use real-life identifiers for airport ICAOs, waypoints, fixes, NAVAIDs, and even a SID or STAR properly as made available, it can not be avoided and formatting would be the programmer's prerogative to achieve successful drawing results within FS Navigator.

The clearance delivery controller is responsible to check and make sure the flight plan is recognized by the system (FS Navigator) at the beginning of each pilot's flight. If not then the controller would need to either correct it or have the pilot correct it. When controlling flights during our virtual ATC operations we look at flight plans in a simple manner (reference the chapter where I discuss flight plans).

Ground Controller – Ground controllers are primarily concerned with aircraft moving about on the airport. FS Navigator does not have detailed airport views that allow ground controllers to provide pilots with exact taxi instructions per taxiway identifications or when directing pilots via progressive taxi instructions. For instance, some taxiways will have taxiway signs and markings that the pilot can see out the cockpit window. Take a look at figure 31 below.

Figure 31 - Taxiway signs at Atlanta/Hartsfield Intl (KATL).

As seen in figure 31 the pilot could navigate per controller instructions by looking out the window and following the signs but the controller must be able to see them on the scope in similar detail as shown here in figure 32, a screenshot of FS Flight Keeper.

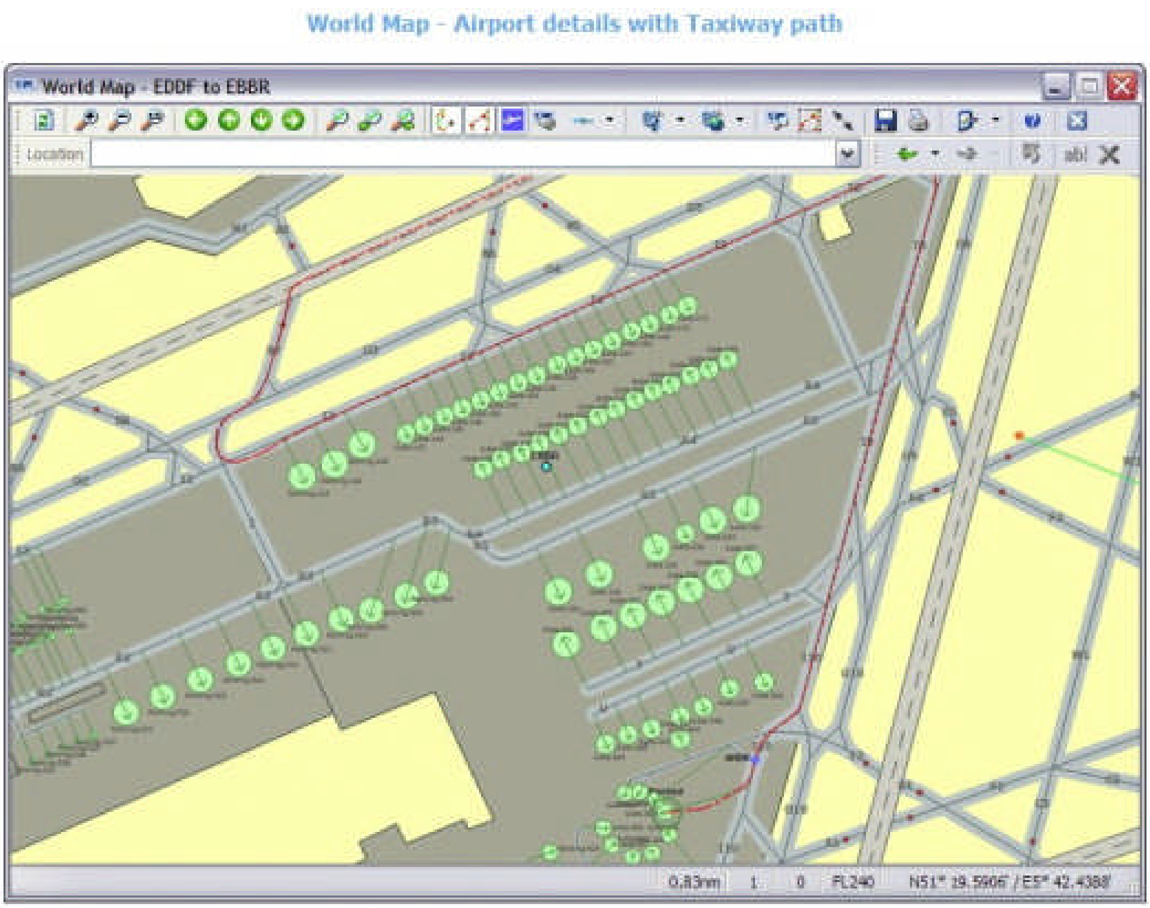


Figure 32 - Taxiway view in FS Flight Keeper.

FS Flight Keeper by Thomas Molitor http://www.molitor-home.de/fs/FLKeeper/default.asp shown above represents the taxiway detail suggested for FS Navigator. It shows detailed parking spots, even showing the size aircraft that could be parked by the size of the green circle (small, medium, and large). Taxiway IDs are abundant and taxiway centerlines make for precise guidance on large "open" ramps (such as depicted by the red line) just like the pilot will see in the scenery. Even though not used as an online ATC tool I included the screenshot to better present what might be.

ATC Radar Screen as previously discussed also provides excellent airport and taxiway views for existing scenery databases, more simplistic but very usable (reference figure 33).

Figure 33 - ATC Radar Screen zoomed in on Charlotte/Douglas Intl (KCLT).

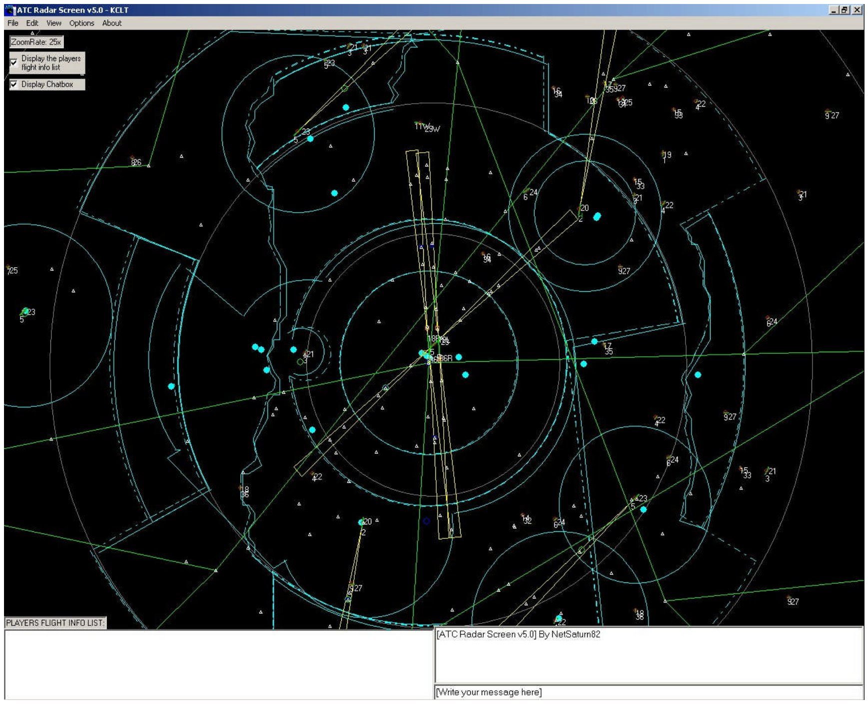


Figure 34 - ATC Radar Screen Tower Mode view showing Charlotte/Douglas Intl (KCLT).

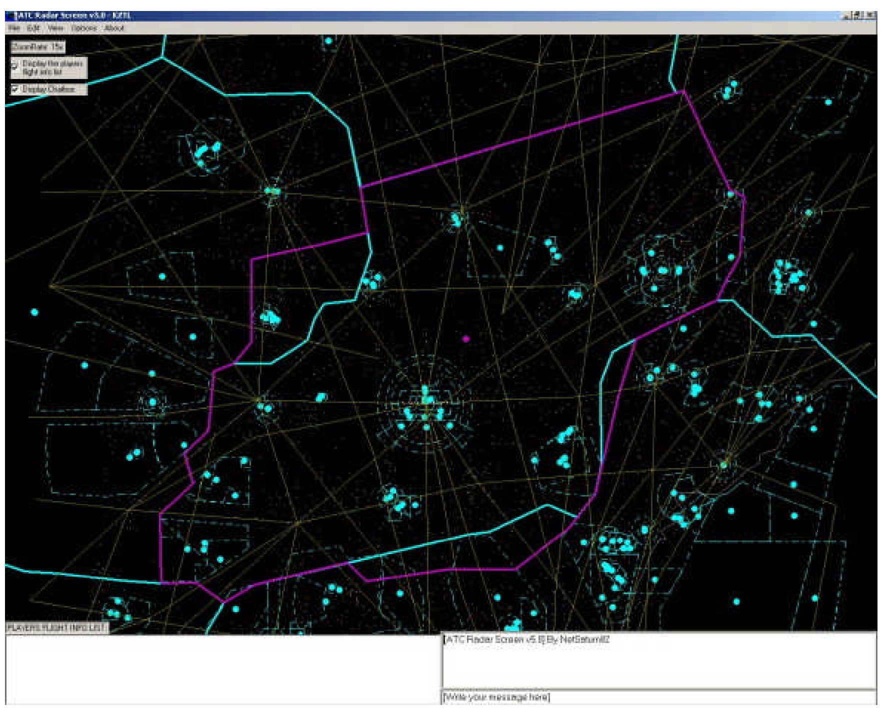


Figure 35 - ATC Radar Screen ARTCC/FIR view showing the Atlanta ARTCC sector.

Tower Controller – Tower controllers are primarily concerned with aircraft taking off and landing. Currently FS Navigator lacks some vital information used during takeoff and landings, one being the current weather. In the lower left of the FS Navigator screen (see the purple annotation in figure 30) is a blank area that could be easily used as a new window to display the weather reported by FSHost. The tower controller needs to be able to quickly reference the wind direction and speed (including gusts), the current barometric setting, and the current visibility. Other weather information for ground level operations could include precipitation type and rate. The barometric setting is also used by center controllers when aircraft are flying below 18,000 feet so they too will find the weather information handy on the main map screen.

Another *very special enhancement* for the tower controller (in our ATC service tower controllers handle this function because they have less a workload) would be a special screen view for performing precision approaches called *PAR (Precision Approach Radar)*. PAR is designed to be a *landing aid* rather than for *sequencing and spacing* aircraft. PAR can be used as a *primary landing aid* or *to monitor other types of approach* such as ILS, VOR, NDB, and GPS). It is designed to display range (distance), azimuth (path) and elevation (altitude) information. Each scope (*actually two scopes in one*) are one on top of the other divided horizontally as shown below, the top scope providing a view of the *altitude and distance* information and the bottom scope providing a view of the *path and distance* information. See the screenshot below for an example.

This to could be by the addition of another button placed under the FMS button (see the green annotation in figure 30) located at the top left of the map screen allowing the map display to be switched instantly to a view similar as shown below. This would allow any controller properly trained to use the correct phraseology to conduct what is referred to as a Ground Controlled Approach (GCA) and act as a "special" approach controller to provide the PAR approach as mentioned.

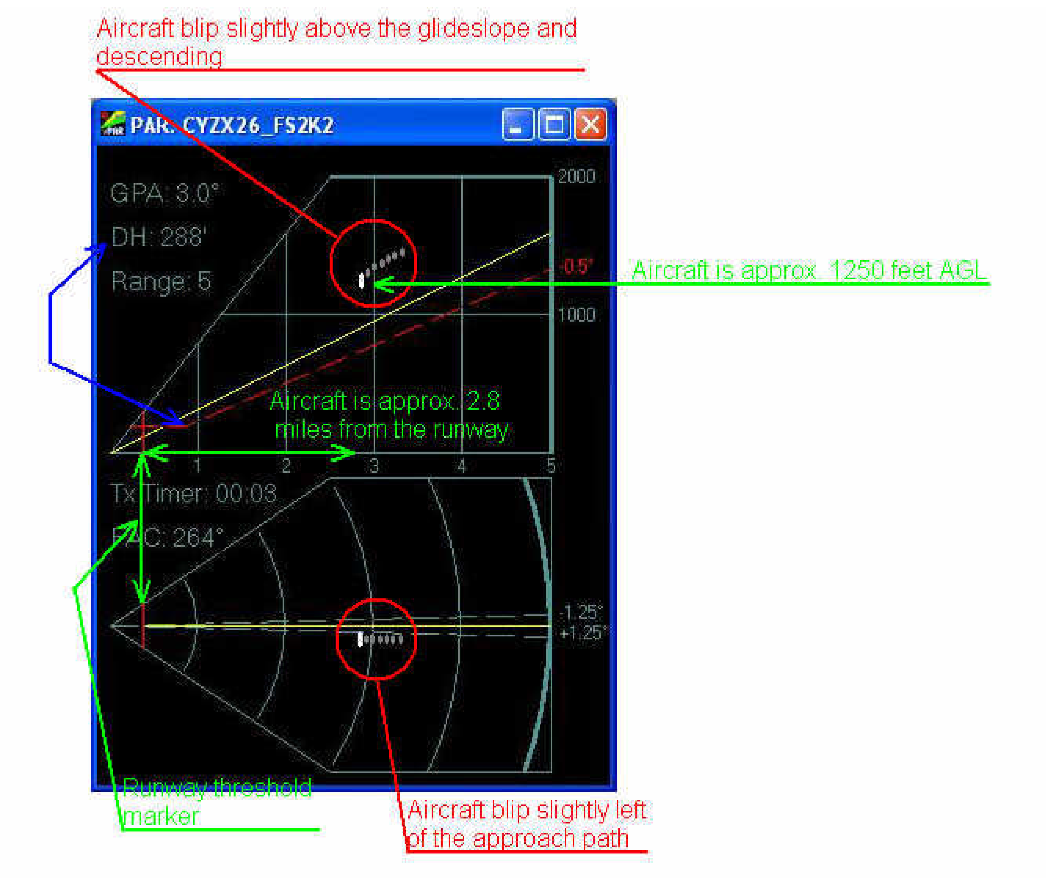


Figure 36 - vPAR depicting an aircraft on a Ground Controlled Approach (GCA) using a PAR radar.

One final note about the tower position, unlike the recent addition of the tower cab in FSX (reference figure 37) that provides an actual view outside the tower (only practicable in a VFR environment) the radar scope as provided by FS Navigator is still the preferred method as it serves not only for IFR operations but VFR operations as well (kills two birds with one stone) with less overhead. The tower cab is "cool" but in the virtual world not so practicable.

Figure 37 - The new FSX tower cab view.

Departure/Approach Controller – This is one of the busiest controller positions, getting aircraft either away and up to their filed route or safely into airports for landing. If a controller is *not* vectoring a pilot, in other words providing lateral and vertical guidance for the pilot instead of the pilot following their own navigation, the problem mentioned about controllers needing flight plans displayed on the FS Navigator map crops up again. Transitions are part of route segments between the airports and primary air route filed by the pilot, specifically departure and approach controllers are concerned about tracking transitions from a departure airport to an en route airway and from the airway back to the destination airport and many pilots may use standardized departure and arrival routes called SIDs and STARs due to complex aircraft being better modeled with FMC units. So if the filed flight plans can not be displayed then it will complicate tracking aircraft movements properly along the filed flight route by controllers.

I have mentioned several times that FS Navigator was designed originally for pilot planning purposes and only one flight plan was expected to be used. Again this situation emphasizes the need for displaying separate flight plans for each pilot on the FS Navigator map while used in multiplayer mode as a controller's scope. This way the controller can allow the pilot to fly the SID or STAR and properly track the aircraft while en route. Using SIDs and STARs is also a great way to affect safe vertical navigation within the virtual world due to the lack of terrain elevation information in FS Navigator. This information is typically a part of SID and STAR vertical profile data. The only real useful terrain elevation data is the sporadic altitudes depicted for various scenery obstacles that are used currently to establish a reasonable minimum safe altitude during ATC activities. Controllers need one of two things, either good terrain altitude references or minimum safe altitude information. If anyone has ever used a VFR sectional chart then they are familiar with the maps being divided into small block shaped sectors that show the minimum safe altitude within that sector to clear any known obstacles in that sector. If such a system could be done in FS Navigator then controllers would have some means to issue safe flight altitudes. Local airport approach charts are typically marked by a minimum safe altitude (MSA) within a 25nm sector of the primary approach NAVAID. This altitude could also be used for initial climb altitudes during a departure until above the sector MSA and on their way en route or during arrivals into the destination airport. This information would be more easily used within FS Navigator even though the use of published real-world charts is the only other "best" way, but many virtual pilots tend not to have or use them.

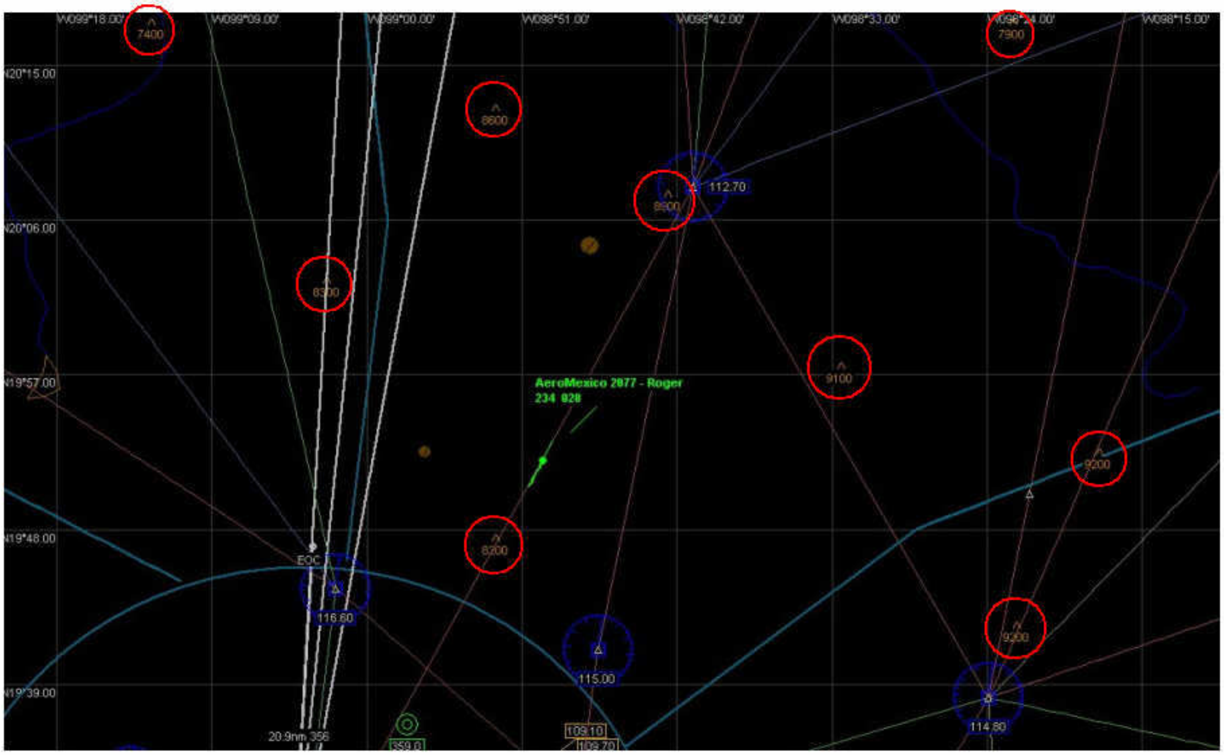


Figure 38 - FS Navigator map with sporadic obstacles and associated altitudes circled in red.

Actually en route altitudes are not as critical for virtual use (the aircraft in figure 38 is climbing safely at 23,400 feet) but when pilots have accurate mesh files loaded in their scenery then controllers must have fairly good information for safe altitudes during takeoffs, landings, and transitions to the en route segments of flight until they are above minimum safe altitudes (MSAs). It can be said that if pilots do it right by using proper maps and charts then there wouldn't be a problem but as stated in the beginning we must address a wide audience in the flight simulator community and presume not all pilots will have these available so the virtual controller must be able to monitor these things as in real-life (at least to the extent possible) to keep the players from becoming a bug smudge on the next mountain top <grin>. Controllers that use FS Navigator typically should use real world charts and maps to supplement their instructions and issue pilots proper instructions for safe altitudes and directions also until a better computerized system is available.

Typical information for an approach might be provided by right clicking on an airport to enable an approach selection that would provide a popup profile view of the selected approach with associated vital information such as the glide slope intercept altitude (available now in FS Navigator when pointing at an airport runway but in text form only) this would greatly aid the controller acting as an approach controller. Look at figure 39 below, a view from the FlightSim Commander program by Sascha W. Felix http://www.fscommander.com/.

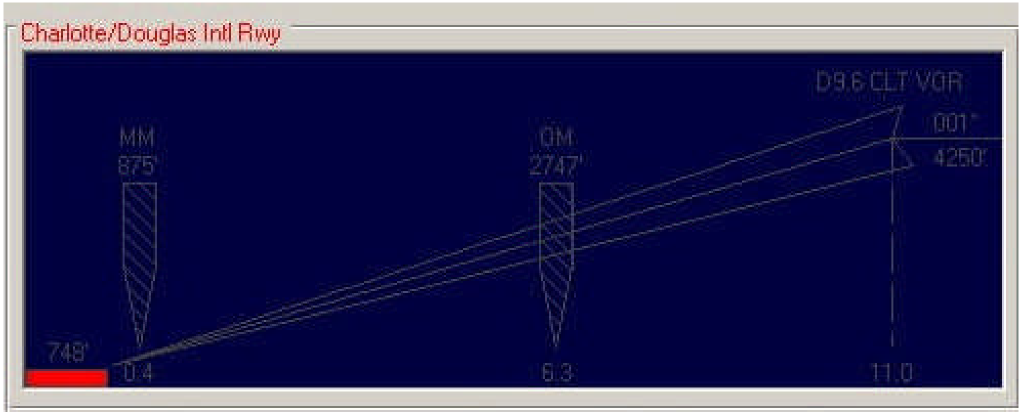


Figure 39 - FlightSim Commander Approach profile view for runway 36L at KCLT.

Figure 39 shows distances to the runway threshold from the depicted markers, an approach bearing, crossing altitudes at the KCLT VOR, the outer marker (which in this case is the FAF and glide slope intercept point), middle marker and runway threshold altitude. If you were to look at a real-world approach chart for 36L the approach bearing is actually 003 degrees and the glide slope intercept altitude is actually 2,900 feet but it is close enough for the virtual controller as the aircraft ILS system will take care of the differences (the differences may be caused by out of date references). The only other bits of vital information that would be nice to have in this view is the ILS frequency and the maximum intercept angles in degrees either left or right of the approach course precalculated for the controller. In this case that would be 31 degrees when approaching left of course or 331 degrees when approaching right of course (*maximum deviation either right or left of the approach centerline is 30 degrees for approach intercept*). This view along with the suggested information would provide the controller most of the information for conducting an ILS approach. If VOR or NDB approaches (both non-precision approaches) are conducted then the pilot (or controller) would need to use real world charts as these have a multitude of "step down" altitudes associated with them. Typically only ILS information is provided in these profile views.

Center Controller – The center controllers regularly need the current barometric reading from FSHost for aircraft flying or descending below 18,000 feet (pilots must set their altimeters from the standard reference datum of 29.92 as set when flying at or above 18,000 feet to the current pressure reading). As the pilot is handed off to subsequent controllers, each controller must again provide the current barometric reading as previously mentioned. Current weather conditions may be requested for the destination airport by the pilot (if not available via a provided ATIS frequency) so again weather information must be available to any controller (as per the purple annotation shown in figure 30).

Center controllers are primarily concerned with monitoring en route aircraft to ensure they remain on the flight plan filed and providing any information or assistance as requested. So the center controller must have quick access to the filed plans of all aircraft or the single flight plan for one aircraft as described previously. Pointing at the aircraft and having the plan drawn on the map would be the best enhancement to monitor flights.

THE ART OF SIMULATING ATC

CHAPTER 2

THE ART OF SIMULATING ATC

Well, we have discussed much about the applications available to the flight simulator community but still the "real mustard" (the methods) of how to pull off an enjoyable and complete ATC session using these software tools is still yet to be seen. In this section I'll do just that, showing you the most beloved secrets of the trade that even the "big boys" still don't use. The methods I'll describe here will tell you how to manage activities based on available controllers (with as low as two controllers, or as many as wish to participate) and provide pilots with a total flight experience from start to finish every time. It also provides insight on how these controllers can manage coverage of the entire virtual planet using some intuitive tools and methods. Gone forever is the day when online ATC activities need to worry about manning every controller position at every location (incorrectly modeled after real-life operations and inefficient for online play) thus allowing virtual ATC services a way to provide pilots the freedom to choose where they wish to fly and still receive complete ATC service when controllers are available online. With better and more innovative software tools these methods themselves will become state-of-the-art for online ATC play.

BASIC MANAGEMENT REQUIREMENTS

ATC activities consist of real people who come together to play out the role of either a pilot or controller. When "playing" no one likes getting bored or stuck with the "unwanted" position all the time. They like to be active participants either to solely have a good time or challenge their own skills. The ATC side of the activities is usually manned by volunteers that may or may not show at each scheduled activity (most of the time due to real-life causes) but yet there must be a way to protect the quality of the ATC service by ensuring each activity is always conducted without fail. If an activity is conducted based on older style management, using a single controller for a single position, as still used today by some ATC services, then this can open a can of worms for administrators. So, presented here from lessons learned and the "school of hard knocks" I'll show you by breaking down the essential concerns how to overcome the problems they present. So what are some of these important points?

1. There has to be a method to allow any number of controllers (from 2 minimum to unlimited) to handle ATC activities. It is assumed that activities are "global" in nature meaning that the entire virtual planet is provided coverage by the available controllers (even though limited coverage activities can still be conducted).

2. There needs to be a way to allow controllers the freedom to act in any position at any time. This prevents controllers from being strapped to one position all the time and provides a more exciting activity for them as well as the pilot by keeping them active at all times.

3. There needs to be a method provided where pilots will always have a controller for each segment of their flight without failure due to the lack of a filled controller position.

4. There needs to be a method for controllers to communicate in the background (without pilots hearing these communications) to coordinate vital information and movements of aircraft.

5. There needs to be a method for controllers to switch "in the blink of an eye" from one aircraft to another. Without this switching capability handling aircraft on a global basis becomes awkward to impossible or causes an activity to be limited to a smaller area.

6. There needs to be a method(s) for displaying filed flight plans on the controller scope. This is needed to allow controllers to track proper flight progression and also provide a

means to initially provide course guidance just after take off or "see" the initial descent point for aircraft arriving at their destination.

These are the basic considerations for conducting an ATC activity and they are not as simple as they look. If you have ever tried to manage an online ATC service you will find each of these present major problems for administrators.

MANAGEMENT OF COMMUNICATIONS

Hands down TeamSpeak provides a very realistic communications environment only lacking a few key enhancements that would make it state-of-the-art. Pilots need frequencies (or channels) to tune to using their cockpit radios to conduct all the necessary communications a real-life pilot might encounter and controllers need a method to communicate efficiently with other controllers in a "back channel" to conduct the coordination required to allow smooth flow of aircraft. The most vital part of TeamSpeak though is not technical in nature but rather how it is used to manage and overcome the weaknesses noted in points 1, 2, 3, and 4.

Take a look at figure 40, notice that the controller labels are kept generic. That is because each controller does not man just one position, such as a ground or tower controller. Rather each controller can perform the duties of any controller position depending on who controlled the pilot last before being handed off.

You're giving me a look like a "deer starring into headlights" <grin>. So what did I just say, well let's take an example to get this point across. Let's say LA1428 "WildDoktor" has just entered the activity. Pilots will always check in with the controller labeled ATC1 first to establish contact with ATC and make their intent known. Whether a pilot is flying VFR or IFR, if ATC service is desired or required then the controller labeled ATC1 is the one to talk to before starting a flight or even while airborne to obtain ATC services.

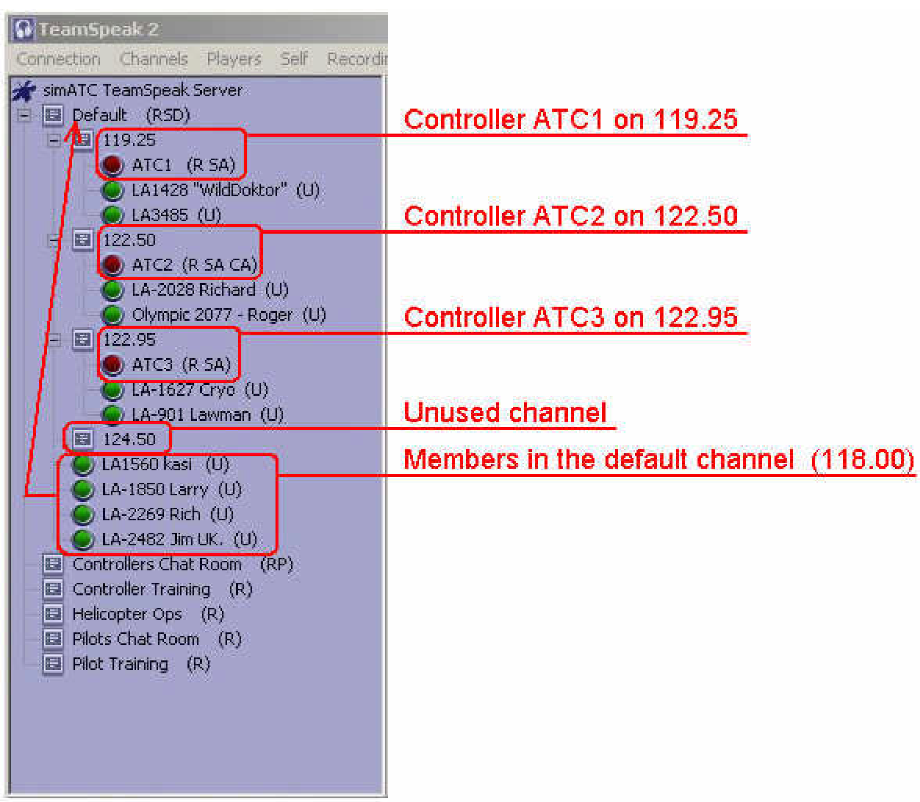


Figure 40 – The left side of the TeamSpeak main screen.

But let's say LA1428 is going to fly an IFR flight from KJFK to KMIA. In our service any pilot who is flying an IFR flight should always address the ATC1 controller as clearance delivery using the name of the airport located at, in this case Kennedy Clearance Delivery and request their IFR clearance (again I'll discuss the technicalities of these flight scenarios later so for now the main idea is to understand how the communications are being handled, not how the example flight scenario is conducted).

Once the clearance is obtained the pilot will be instructed to contact the ground controller for engine start and taxi via the provided frequency 122.50 (which just happens to be the next controller down in the list). When the pilot is ready to start engines s/he contacts the controller labeled ATC2 addressing them as Kennedy Ground. It is the pilot's responsibility to keep track and properly address subsequent controllers during all frequency changes. The ATC2 controller will be advised via the TeamSpeak "back channel" by ATC1 to expect the pilot preparing for departure and even told the position ATC2 can expect to simulate, in this case Kennedy Ground.

So, you see here it does not matter where the pilot is located either on the ground or in the air when requesting ATC service, ATC service and the cycle of controller positions will always start with the ATC1 controller. When the bottom of the list is reached (it doesn't matter how many controllers are participating in the activity) the last controller pushes the pilot back up to the controller labeled ATC1 and the cycle continues with the next required controller position until the pilot completes their flight. Using our method just gets better if more controllers are available as there will be more voices for pilots to hear and the randomization of the cycle is better allowing the active controllers a better opportunity to handle different controller positions.

As a further example, if a pilot joins a session taking off from an uncontrolled airport, flying VFR, and then wishes to enter controlled airspace and land at a tower controlled airport the pilot would call ATC1 and address them as approach for the airport where the landing is intended (just as in real-life) telling the approach controller the intent to land or some other option such as to practice ILS approaches. The next controller in the list, in this case ATC2, which the pilot is handed off to, would then assume the duties of tower, and the next (ATC3) ground.

If a VFR pilot just wanted flight following after going airborne then ATC1 would be addressed as the center controller who has responsibility for the location where the aircraft is currently located when the request is made (again just as in real-life). It is vital the pilot understand how to properly determine and address the ATC1 controller depending on their situation (the ATC1 controller might be contacted as clearance delivery, ground, approach, center or even just to get information such as simulating a flight service station). After ATC1 establishes flight following for the pilot the controller will hand off the pilot to the next controller in the list ATC2, ATC3, and so on to other ARTCC/FIR sectors as the flight progresses either until landing or canceling the flight following.

So, as a flight progresses either VFR or IFR each subsequent controller picks up the next position. The pilot will never experience the loss of service as might occur in other ATC services that depend on manning each position with a single controller at a single location which is inefficient for virtual purposes. Also, if 10 controllers are expected to show up for an activity but only 5 actually do then there is no loss of ATC coverage using the above described method for pilots flying flights *any place on the virtual planet*. The 5 can perform just as the 10 would have. The only difference the pilot's see are the number of voices and frequencies available for use, easily overlooked for the sake of fun and considering the results achieved <grin>.

So in summary you can see point number 1 is taken care of by the simplicity of the communications cycling method used. The reason the minimum recommended number to control is two controllers is to ensure pilots have the opportunity to actually change channels in the cockpit (using TSComSet) and have more than one voice to hear. Even though one controller *could* still do the job, the channel changes would have to be simulated (by giving the same frequency for each frequency change) as there would not be an actual second controller to switch to.

This cycling method also provides the opportunity for controllers to handle more than one controller position during the activity depending on the position of the last controller who handled the pilot. Due to the random number of ARTCC/FIR sector boundaries that will be encountered along a flight route the cycling of controller positions becomes juggled or randomized. So this takes care of point number 2 where controllers not only like to stay busy but like to handle various positions during a single activity. Controllers may be handling the duties of tower for one pilot but approach for another pilot. It is very important that controllers hand off pilots where and when required. This will ensure the cycle randomization occurs allowing controllers the opportunity to handle various positions during the activity. One controller will not be strapped to one position either at any one location or several at the same time. This prevents problems with simultaneously trying to handle different locations at the same time for a single controller position or having to twiddle their thumbs waiting for the action to arrive at one location. They will continually be tasked to perform in any given position depending on the amount of air traffic and routing of flights.

Point 3 is always taken care of due to the cycling method. If an activity was based on one controller manning each control position (such as ground, tower, departure, and so on…) but then for uncontrollable reasons one had to leave the activity, this would create a "hole" in that position, pilots may not receive a total flight experience. In our case the cycling method absorbs the loss. The pilots present in the channel of the controller that must leave the activity only need to be handed off to the next controller (or even spread out amongst all the controllers further randomizing the cycle) and from there the cycling continues among the remaining controllers. If the controller returns later before the end of the activity they can come up as the ATC number they were and start taking pilots in the cycle from there or if that position is filled they can take the next ATC number in the list and pick up on the cycle there. This works great to blend in controllers even if late for an activity. It also works well to cover a controller disconnected for reasons beyond their control such as a storm.

The key to making points 1, 2, and 3 work well is the controllers "back channel" mentioned in point number 4. Without the back channel, coordination would be clumsy to impossible. The back channel is the method used by the controllers to coordinate the work. In the back channel controllers can coordinate such things as what a controllers next position will be for a pilot being handed off, or the active runway for takeoff or landing, helping out other controllers with vital information for weather if another controller doesn't currently have access to the information, reminding other controllers who are extremely busy about pilots that need a sector change, handling a controllers pilots if they have problems with FS Navigator and can not "see" the aircraft on their scope and much, much more.

Using the TeamSpeak Channel Commander Feature and whisper mode, a back channel can be created and utilized just for this purpose. The back channel allows the controllers to "do their thing" without disturbing the frequencies used for ATC communications with the pilots. So, seen here in this discussion TeamSpeak provides the primary means of managing an ATC activity properly. Without this great tool for use during such activities many aspects of real-life aviation could not be reproduced.

MANAGEMENT OF FS NAVIGATOR

When it comes to the art of multiplayer activities FS Navigator solves point number 5 via a neat small feature it has, and even though it can not do exactly what number 6 describes there are some cheats I'll describe here to improve the situation. Also FS Navigator works well to determine where controllers should hand off pilots to subsequent controllers during a flight.

Figure 41 depicts the ARTCCs for the U.S. continent. The light blue (or cyan) lines are the indicated boundaries for each ARTCC. Each time an en route aircraft crosses one of these boundaries the current controller of an aircraft should hand off the pilot to the next controller listed in TeamSpeak as the center controller named for that sector.

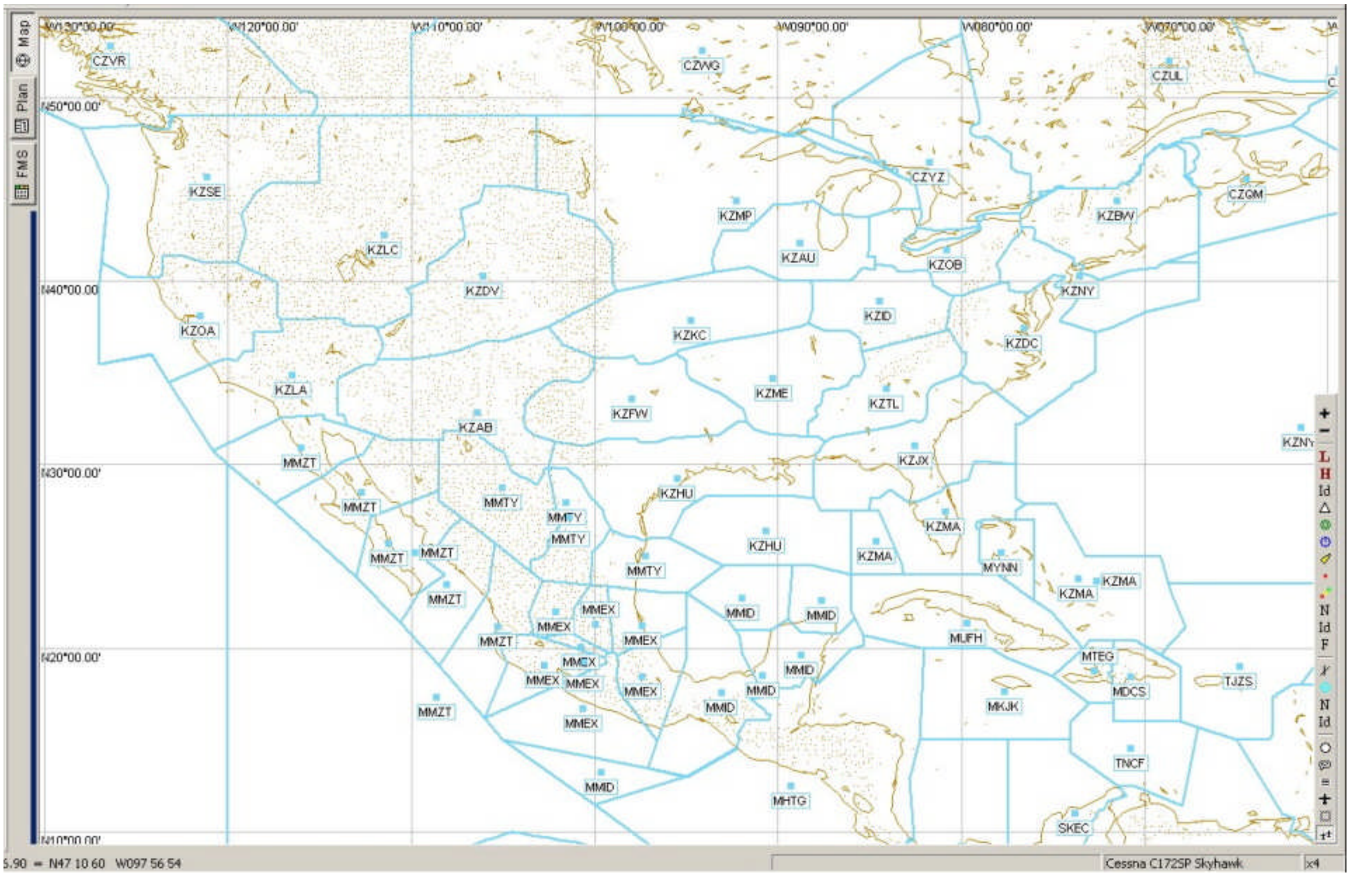


Figure 41 – U.S. Continent and Mexico ARTCC/FIR zones.

There are only a few situations where there are exceptions to this rule. When departing or arriving aircraft are in proximity of a sector boundary then the aircraft may be considered not en route but rather in a departing or arriving mode where either a departure or approach controller might be more appropriate to take control of the aircraft. Let me explain this further. Figure 42 below depicts the region around the Charlotte/Douglas International airport and the associated airport control zones. You will notice it is closely bordered to the south and east by two other sectors. The one to the south is the Jacksonville ARTCC and the one to the east is the Washington ARTCC. The airport itself is in the Atlanta ARTCC.

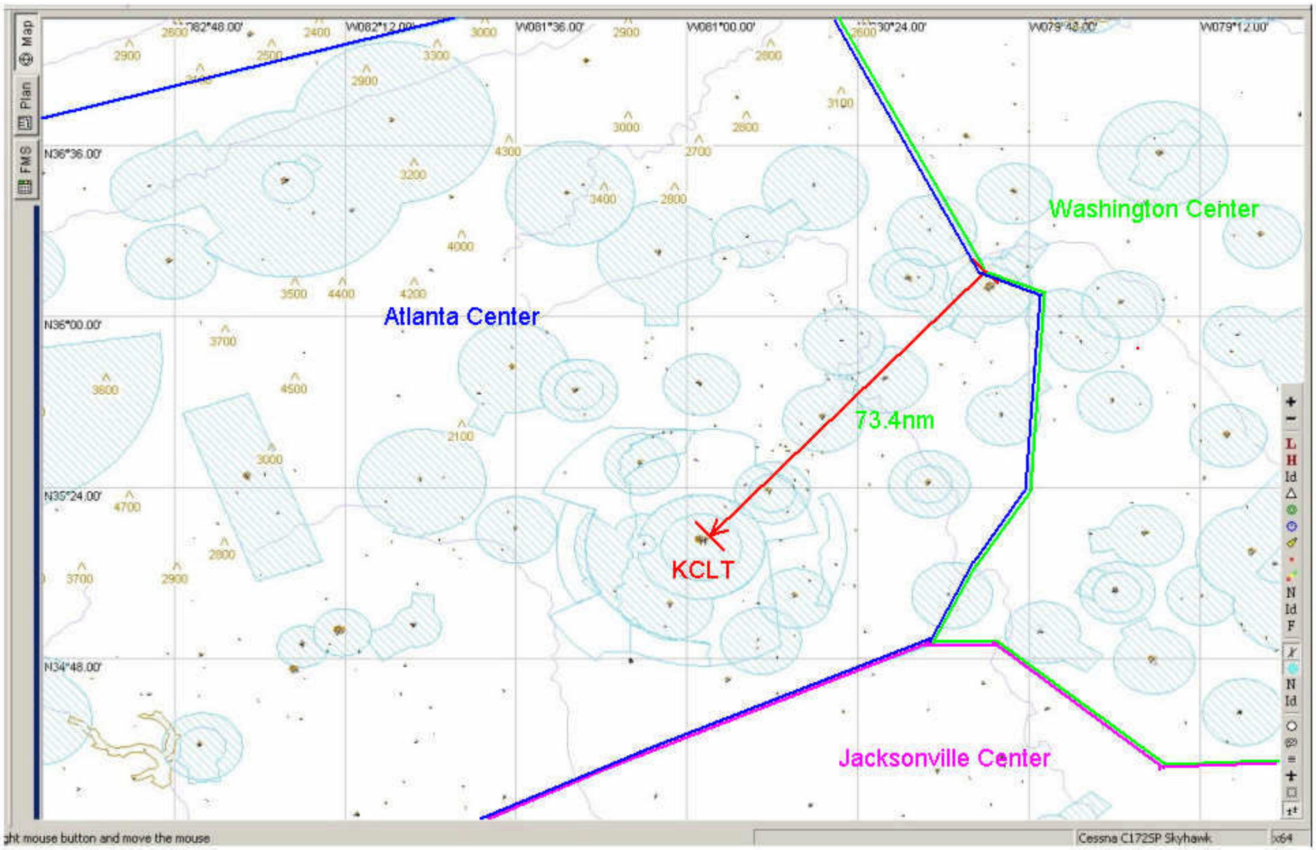


Figure 42 - KCLT Region and associated airport zones.

If an aircraft were approaching the airport from the northeast as shown by the red arrow and would only be traversing the airport area en route then the controller acting as the Washington Center controller would hand off the aircraft as expected to the next controller in the TeamSpeak list as the Atlanta Center controller but if that aircraft will instead be landing at the Charlotte airport then at the Washington/Atlanta border (where the red arrow starts) the controller would not hand off the pilot to Atlanta Center because the range of 73.4nm is suitable to go ahead and hand off the pilot to Charlotte approach. If the distance were any greater than this, then it might be more appropriate to hand off the aircraft to the next center for a short distance until within approximately 60-70nm from the airport which is a typical range under approach control. This will of course affect the outcome of who in the list will actually be the approach controller due to the extra hand off executed. So it is important to make each hand off at the correct time to give all active controllers the proper opportunity to act in the controller positions expected.

Point 5 is taken care of by a special feature (a small pull down window) which lists all the multiplayer identifications so that the controllers can quickly select that players aircraft and have FS Navigator zoom to the aircraft regardless of it's location on the virtual planet (reference figure 43). This makes it easy for controllers to manage global activities with large numbers of connected players. If this feature were not available then searching for aircraft on the virtual planet would be too difficult during busy situations.

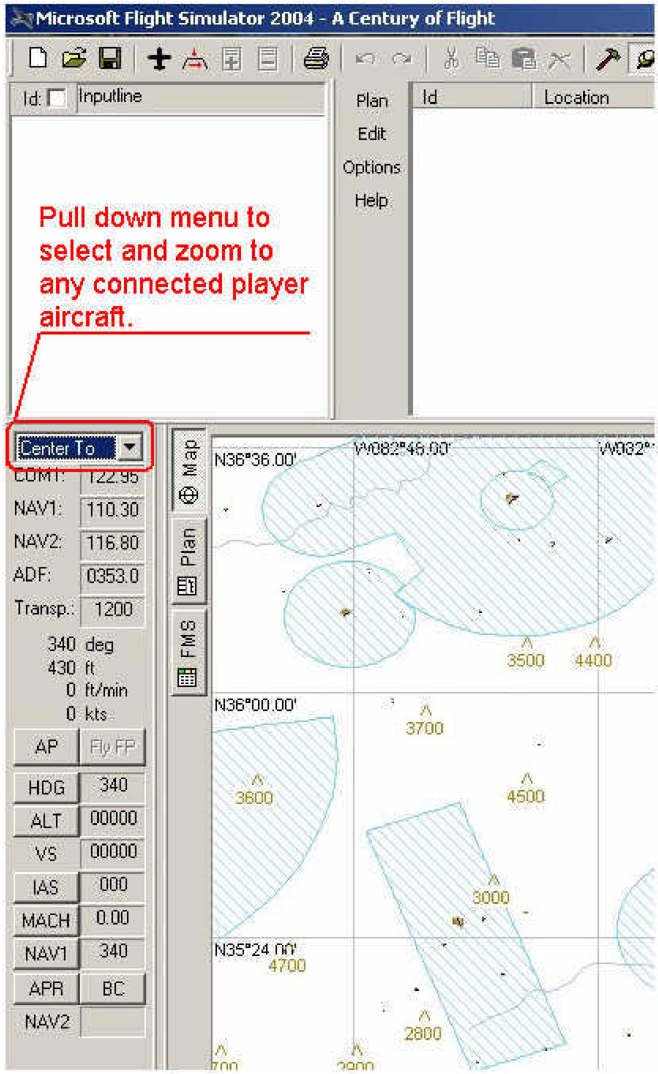


Figure 43 - Location of the pull down menu to center on specific aircraft depicted on the FS Navigator screen.

Point 6 is not available within FS Navigator as it was originally designed as a flight planning tool for virtual pilots and handles only a single flight plan at a time. Display of multiple flight plans is not possible, but as hinted there are some work around solutions that can help.

The need to mark all airports filed by pilots as either a departure or destination airport should be obvious. When aircraft depart an airport the controller needs to know which way to initially vector the pilot away from the airport (if they are not flying a SID to begin with) to get them started on their way in the correct direction and when aircraft near their destination the controllers need to know the aircrafts location in relation to the destination airport to judge a proper time to descend the aircraft.

“Spiders” as seen in figure 44 are not typically exact depictions of filed routes (even though that is on the wish list <grin>) but a mere way to quickly and easily identify all the airports in filed flight plans indicated at the end of each line including the airport in the center. If the ATC activity covers a specific area the airport nearest the center of the spider usually is designated as the activities primary airport.

If pilots depart from the KCLT airport (depicted at the center of the spider in figure 44) to any of the outlying airports then the “general” direction of flight is shown by the spider lines and the controller can easily figure out on departure which direction to send the pilot. If any pilot departs from any of the outlying airports to fly back to KCLT at the center those to can be properly vectored (with the lines depicted by the spider). Even if a pilot flies from any outlying airport to another outlying airport (where the lines are not drawn) it is still fairly easy to see a proper vector (such as in general compass points, N, E, S, or W) because the controller can easily identify each airports location using the spider. Still due to the fact individual flight plans can not be automatically drawn as filed by pilots via the chat window and listed by FSHost limits the use of this cheat.

The other use of the spider is to enable controllers to better judge initial descents into a destination airport. When controllers are watching several aircraft at once on the map that are nearing their destination it is typically done by zooming the map out so they can keep track of the remaining distance (they use the measurement feature provided by FS Navigator), but even with airport identifiers turned on in FS Navigator the airport identifiers disappear when zoomed out to far (as may be required for operations) and are then depicted as X's that must be pointed at by the mouse cursor to identify the airports. Without the spider this would become a controller's worst nightmare as there are hundreds of X's on the map and that just won't work in real-time management of aircraft flow. Note that the same is true for the previously discussed ATC Radar Screen program, one of its more major short comings because there are no decent "cheats" for that program such as the spider used here in FS Navigator.

These spiders can only benefit when doing limited area activities as depicted in figure 44. It doesn't prevent conducting global activities but can present a challenge for controllers when busy. For instance, if a flight plan were needed in this case from Heathrow Intl to Charles-De-Gaulle then a line would extend from Charlotte across the Atlantic Ocean to Heathrow to Charles-De-Gaulle then back along the same route, back across the Atlantic Ocean, back to Charlotte to accomplish the task required, doable but inefficient because the line can not be broken to display separate flight plans.

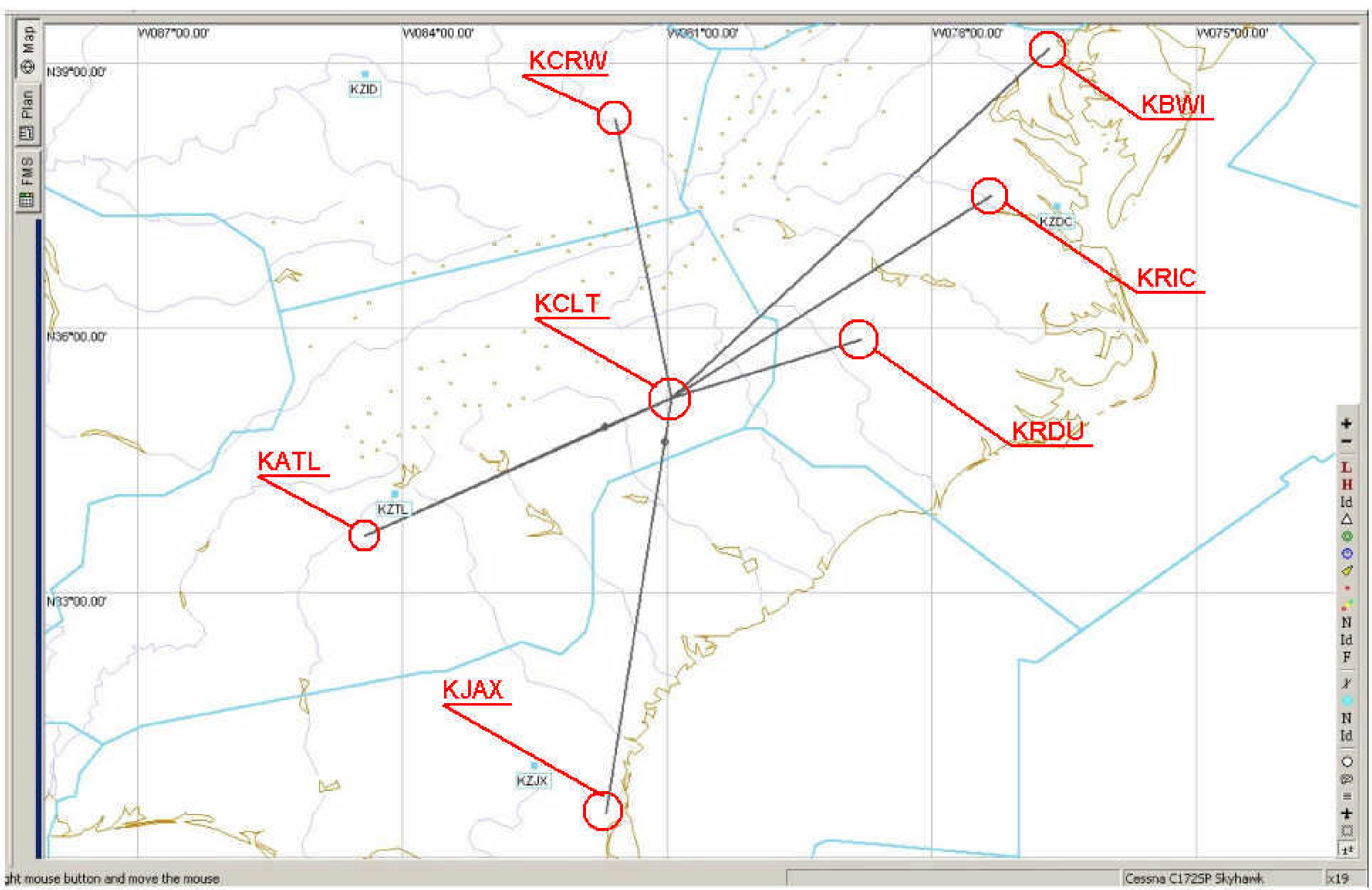


Figure 44 - "Spider" showing all departure and arrival airports on filed flight plans.

In figure 44 Charlotte/Douglas (KCLT) is the center of the spider reaching out to Charleston WV (KCRW), Baltimore/Washington MD (KBWI), Richmond VA (KRIC), Raleigh NC (KRDU), Jacksonville FL (KJAX), and Atlanta GA (KATL). KCLT being nearest to the center of all the airports is chosen as the primary airport (or point of origin for the spider) and is listed first (as seen in figure 45 below) then one of the other airports a pilot will either depart or arrive at is entered next (KATL is second in the list shown in figure 45). The trick now is to bring the line back to the point of origin (KCLT) before going on to the next airport that way the line doesn't go from KATL to the next airport (this keeps the spider simple to read by the controller using a central point). The line must be drawn back over the previous line because there is no available function to "skip" to different areas, sort of like using an Etch-a-Sketch board (I had one when I was a kid did you? <grin>).

Id	Location	Freq	Course	IAS	VSpeed	Altitude	Distance	ETE	Fuel [Lbs]
KCLT	Charlotte/Douglas Intl		-	-	-	748	2645.7	22 40' 41"	0.0
↗	End of Climb		245	95	419	11000	2603.4	22 16' 14"	27.7
KATL	The Hartsfield Atlanta Intl		245	100	0	11000	2449.0	20 57' 06"	99.5
KCLT	Charlotte/Douglas Intl		65	100	0	11000	2252.4	19 16' 16"	190.9
KBWI	Baltimore-Washington Intl		49	100	0	11000	1939.1	16 35' 35"	336.6
KCLT	Charlotte/Douglas Intl		227	100	0	11000	1625.7	13 54' 53"	482.4
KRIC	Richmond Intl		60	100	0	11000	1403.2	12 00' 45"	585.9
KCLT	Charlotte/Douglas Intl		238	100	0	11000	1180.6	10 06' 38"	689.4
KRDU	Raleigh-Durham Intl		76	100	0	11000	1068.1	09 08' 57"	741.7
KCLT	Charlotte/Douglas Intl		255	100	0	11000	955.7	08 11' 16"	794.0
KCRW	Yeager		356	100	0	11000	763.5	06 32' 44"	883.3
KCLT	Charlotte/Douglas Intl		176	100	0	11000	571.4	04 54' 12"	972.7

Figure 45 - Partial screenshot of "Spider" entry.

The ideal situation would be to have a way to allow flight plans entered by all connected players to be automatically displayed individually and/or all at once on the FS Navigator map as previously suggested.

If a controller really has lots of time (and most of the time they don't) you can make the spider more complete by inputting all the waypoints a pilot has filed on a flight plan to see exact routes but that list in figure 45 can really get long <grin>. It is usually the last controller on the TeamSpeak list trying to do this at the beginning of an activity as the first and second controller will be busy trying to give out departure clearances and taking care of taxi operations. The trick again is to duplicate all the waypoints in reverse order and return to the point of origin. With large multiplayer activities this method is usually not done as time will not permit it. Notice how the Charlotte ICAO is repeated in figure 45 to accomplish drawing the simple spider as seen in figure 44 then imagine placing however many waypoints the pilot has filed just like that for each flight plan going forward then in reverse, it can be the kind of thing that makes a fellow want to bite nail heads off <grin>.

There is one other way to "cheat" FS Navigator and get the flight plans depicted individually as filed by pilots but requires a bit of technical work on the part of each controller and advanced planning by each pilot. The pilots must be able to provide their individual flight plan in the native FS Navigator format (basically they need FS Navigator to make the flight plan to send to each controller) otherwise a controller would have to do it for them taking up valuable time. Also, each controller must prepare there FS Navigator to be used in the method suggested.

Basically it involves preparing FS Navigator with a blank flight plan folder (any FS Navigator flight plans used by controllers for their own personal flight planning purposes on their local computer must be moved to a temporary folder. The empty folder is then used to "dump" each flight plan into provided by the pilots that will participate in a scheduled activity (usually emailed or sent by a file transfer capability to each controller such as FTP) and placed into the empty FS Navigator flight plan folder. Then the controller only needs to open each flight plan just once. When that is done the flight plans will be listed under the "Recent Files List" as shown in figure 46 below. The recent flight plans has a limited number that can be displayed but once on the list the controller can quickly pull down the list and switch to any flight plan listed. This will cause that single plan to be displayed. Typically the flight plans would be named with the same name as the aircraft/pilot identifier used during the activity to allow the controller to quickly locate the proper flight plan. This actually is a great "cheat" as the controller can see the exact flight plan filed including any SID or STAR used. It just takes a little more work.

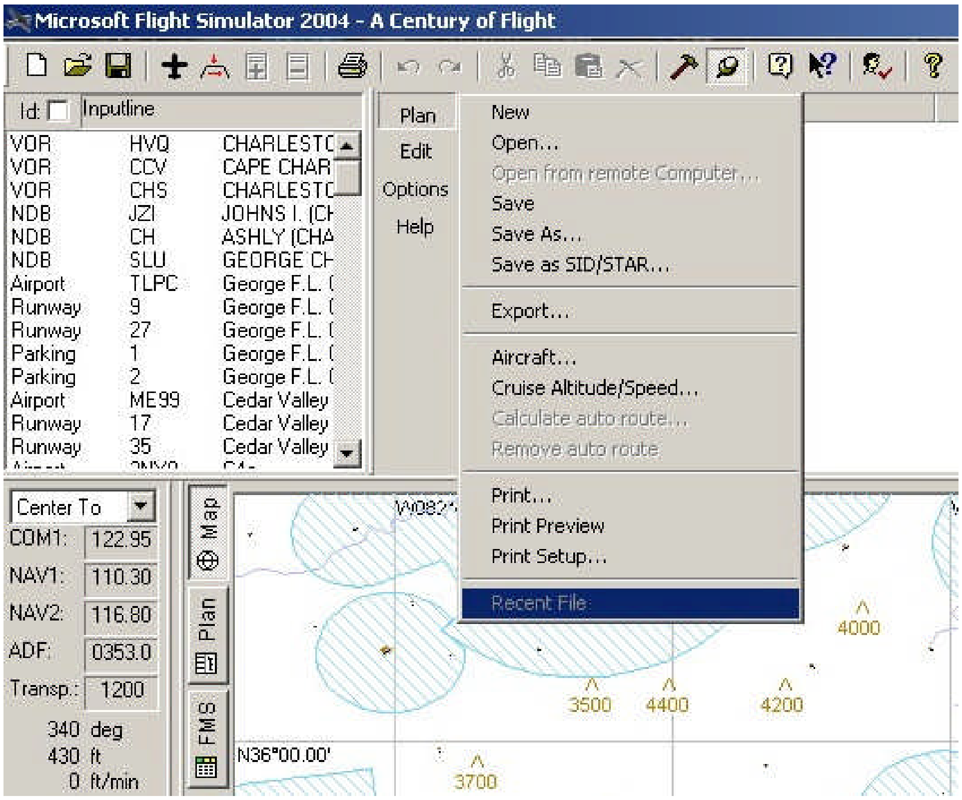


Figure 46 - Location where recent flight plans would be listed.

So this method to display individual flight plans like the other methods described to easily locate departure and destination airports are limited and fall short of any ideal method, but regardless provides a workable solution. They are the best methods to date with the current capabilities in FS Navigator but what a hoot it would be to get enhancements that would provide the capability to automatically display any filed flight plans entered by connected pilots.

MANAGEMENT OF WEATHER

Weather management is straight forward here because the options for providing weather are very limited. FSHost provides a means to set weather manually via an interface discussed earlier in this chapter. I'll briefly review this now.

No real-world real-time weather feed is currently available via FSHost. The controllers (or FSHost administrators) can start off by manually setting up a "global" weather scenario at the beginning of a "live" activity. Pilots receive their initial weather from a posted (textual) ATIS message in TeamSpeak if available or from a controller at the appropriate time. During the activity when most pilots are airborne en route a controller may change the weather to provide a simulated changing weather scenario. The weather pattern can be set using many parameters to provide a wide range of weather scenarios challenging VFR and IFR pilots alike. Here is another look at that interface in figure 47.

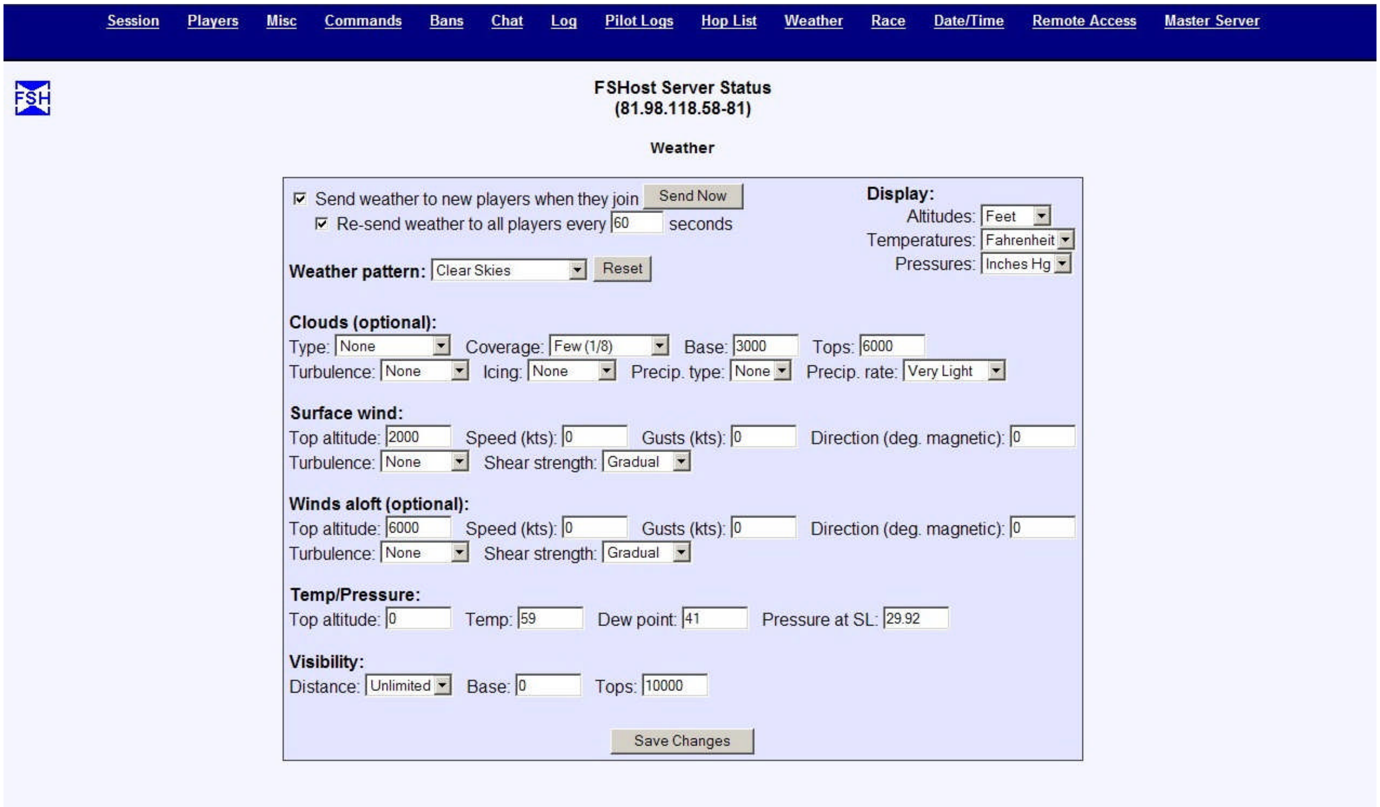


Figure 47 - The FSHost Weather Page.

COMMON ELEMENTS OF MULTIPLAYER FLIGHT

CHAPTER 3

COMMON ELEMENTS OF VFR AND IFR FLIGHT

In this chapter I'll discuss the common elements of VFR and IFR flight. These are elements of flight that pilots will use during any flight not specific to VFR or IFR conditions. Such elements include discussions about airspace, towered and non-towered airports, use of altitudes, flight plans, flight preparation, airways, types of navigation, emergency procedures, and safety of flight. All these elements can be used by either the VFR pilot or the IFR pilot, and are discussed from the perspective of online ATC activities. Later chapters will discuss specific elements for both VFR and IFR flights again from the perspective of online ATC activities.

AIRSPACE

You would think with all the airspace above the planet surface that there wouldn't be any worry about the skies being so crowded that you would have to worry about actually running into another aircraft, but it has happened and it wouldn't be the last time to happen if we didn't apply rules on how to operate within that airspace. This includes operating at minimum safe altitudes to avoid collisions with the terrain and man-made obstacles built on that terrain. So to promote safe and efficient movement of aircraft various airspaces have been established with corresponding restrictions for operations within these airspaces creating "controlled airspace" zones. In the virtual world it is not as critical as and much more forgiving than the real-world so we don't need to burden the simulator pilot with all the rules as used in the real-world, but we do need to apply some basic rules for multiplayer activities. Pilots and controllers need to be able to recognize the difference between what should be considered controlled airspace and uncontrolled airspace and operate properly within each.

CONTROLLED AIRSPACE

Controlled airspace is airspace of defined dimensions within which air traffic control service is provided to IFR flights and to VFR flights in accordance with the airspace classification. Controlled airspace usually surrounds airports with an active control tower as depicted in figure 48 below in the class B, C, and D airspaces (notice the small black looking pegs in each airspace depicting a control tower). The airspace around these airports can take on many forms. Look at the class B airspace (normally a major airport) which resembles an upside down wedding cake, called a TCA (Terminal Control Area).

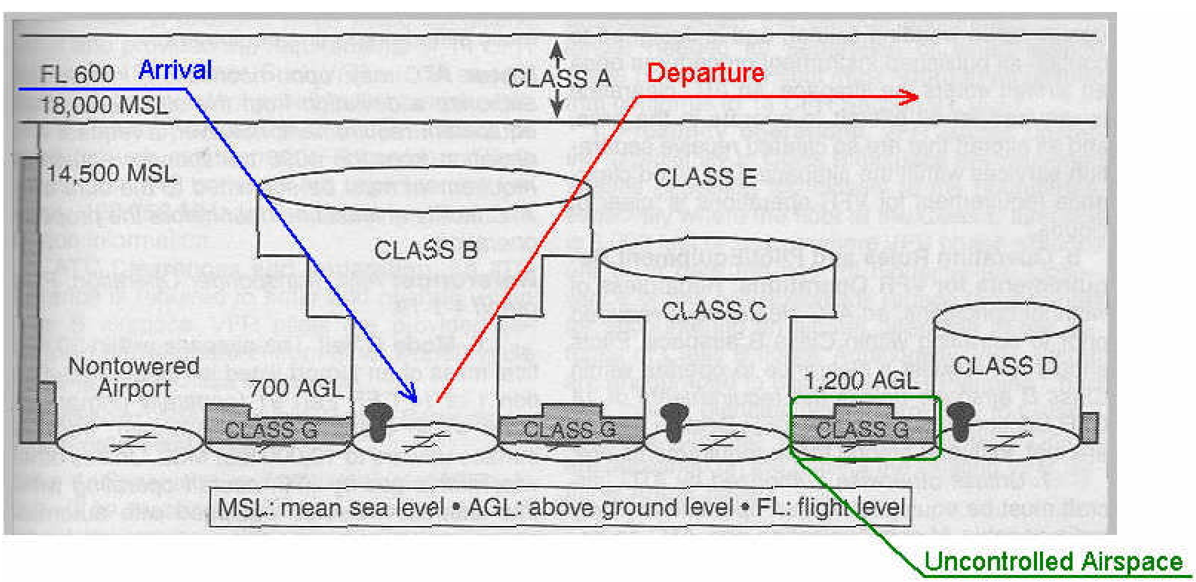


Figure 48 - Basic breakdown of U.S. airspace.

Let's compare the class B airspace depicted in figure 48 with an actual VFR sectional chart view as seen in figure 50 below. Each layer of the cake has a lower and upper limit depicted on the sectional chart, more clearly shown in figure 49 below. The TCA surface layer extends from the surface (over the airport area) to 10,000 feet MSL at its highest point. Layer 1 has a base altitude of 1,800 feet MSL and a top at 10,000 feet MSL. Layer 2 has a base altitude of 6,000 feet MSL and a top at 10,000 feet MSL.

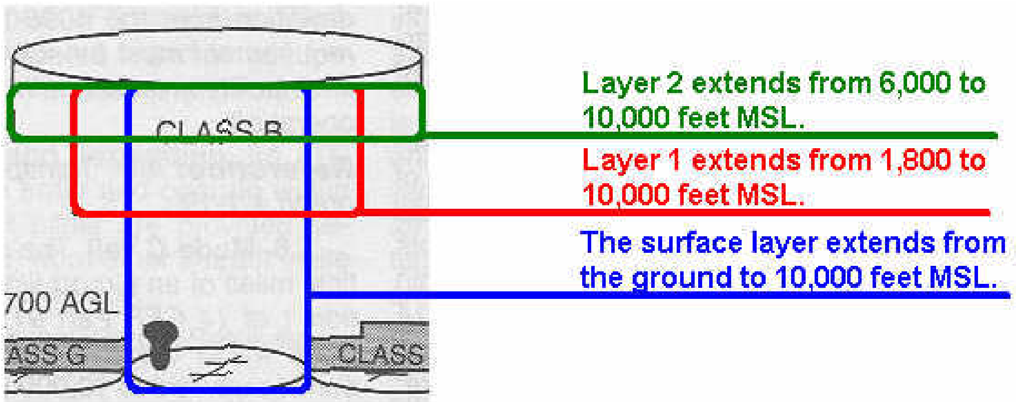


Figure 49 - Class B airspace layers.

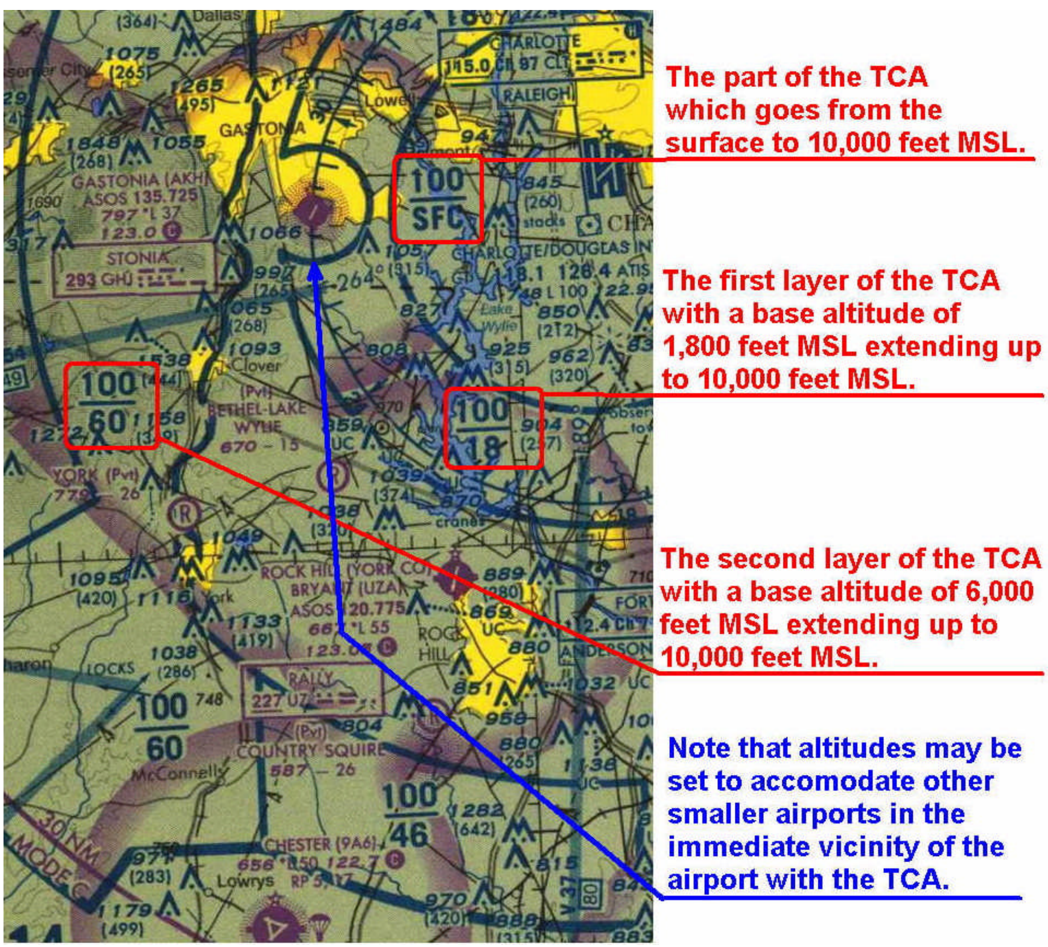


Figure 50 - Sectional chart TCA altitudes.

The TCA such as depicted in figure 49 and 50 above aids in the safe movement of departing and arriving aircraft (typically commercial and corporate) to and from higher altitudes (the transition phases of flight from en route altitudes) as depicted in figure 48. Most jet powered aircraft operate more efficiently at higher altitudes and will normally have a cruise altitude above 18,000 feet within Class A airspace (where all aircraft are under ATC control). Even though it is possible for VFR aircraft to share some of this airspace it is typically the commercial and corporate variety that frequently use the airspace.

It is normal for the VFR pilot flying smaller aircraft to routinely avoid penetrating a TCA by flying over or under one of the “tiers” of the upside down wedding cake. Also, it is not unusual for VFR pilots to skirt under a TCA to get access to smaller nearby airports. If you examine the sectional chart (figure 50) above you’ll find that the Gastonia and Rock Hill airports are underneath the KCLT TCA. Because the TCA has these “tiers” pilots can routinely fly into and out of these airports with little or no ATC contact.

Some TCAs have designated VFR corridors through them that provide a “pipe” for VFR pilots to fly through the TCA itself normally shown on VFR sectional charts as seen below in figure 51 for the KLAX TCA. In the case of this corridor the VFR pilot must obtain an ATC clearance and maintain the assigned altitude. The corridor is along the Van Nuys (VNY) VOR 140° radial. Corridors such as this allow pilots to more expeditiously traverse the KLAX area without extended deviations or altitude requirements.

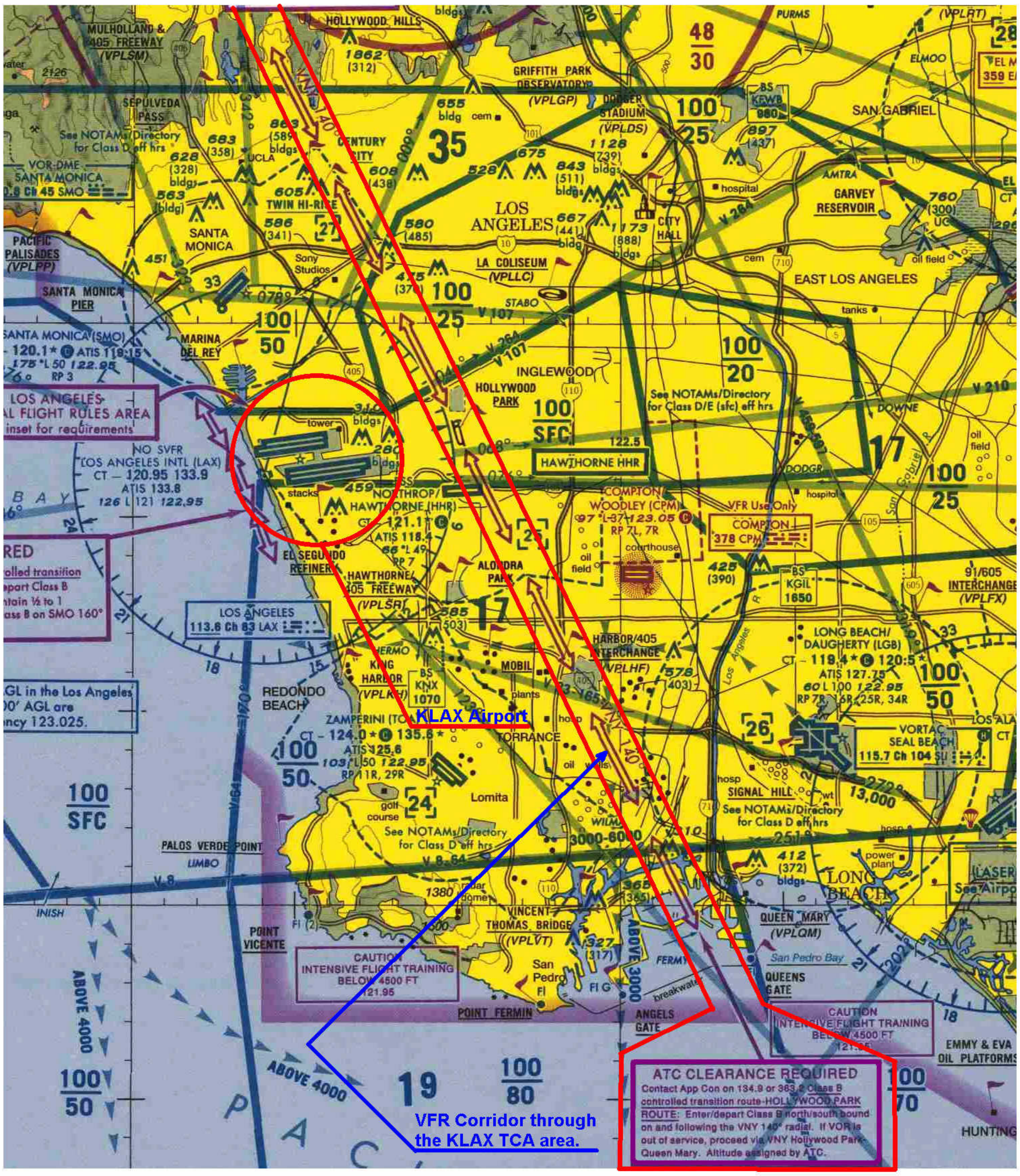


Figure 51 - VFR corridor through the KLAX TCA.

UNCONTROLLED AIRSPACE

Uncontrolled airspace is classified as Class G airspace and <u>is the portion of airspace that has not been designated as Class A, B, C, D, or E airspace.</u> If you wish to learn more about these different airspaces then reference the AIM Section 2 through 5 for a complete explanation. By defining controlled and uncontrolled airspace we can start to apply some simple rules for airspace use.

TOWERED AND NON-TOWERED AIRPORTS

When it comes to a pilot landing and taking off from a runway at any given airport the look and feel is the same, an airport with a control tower or without doesn't look any different from the air. But there ends the similarity, the two are quite different in many ways. The airport without a tower (also referred to as an uncontrolled airport) is normally governed by a fixed base operator (the owners and operators of the airport) and pilots fly into and out of these airports based on standard operating procedures each learns when a student pilot. The airport with a control tower is typically surrounded by controlled airspace (also referred to as a controlled airport) and under the authority of Air Traffic Control. As such pilots are not allowed to move about in these designated air spaces without ATC approval. So if departing an airport with a tower it is mandatory for either a VFR or IFR pilot to get permission before "moving" within the airspace either on the ground or in the air. If arriving at such an airport pilots must contact ATC for permission to enter the airspace. Airports with control towers tend to be more busy than those without, due impart to scheduled air traffic, either passenger or cargo. The more busy and congested these airports are the more restrictions that apply as to the type of pilot that can easily get access to them. For instance, FAA guidelines restrict student pilots from entering the airspace surrounding most major airports with scheduled carriers. Even private pilots may need to obtain a scheduled arrival time via advanced approval to these major airports. Here I'll describe how the virtual pilot can tell the difference between the two types of airports (towered and non-towered) during online ATC activities and how this effects online play.

TOWERED AIRPORTS

In the real-world a controlled airport is usually one that has a manned and operating control tower. This is normally found in up-to-date airport references the real-life pilot must carry with them that provide hours of operation for towers (*some are not manned 24/7*).

So exactly how do we determine if an airport is controlled for virtual purposes? The easiest is to determine if an airport has a control tower frequency listed for it. Each ATC service may have different guidelines on this, *but generally the rule-of-thumb is the controllers will, based on their data, make the final decision if an airport is controlled via a listed tower frequency*. Most of the time this data will match between pilot and controller, it is uncommon for it not too so the pilot need not worry too much. If unsure just ask the controller. So for the purposes of our discussion controlled airports can be defined as follows, *any flight simulator airport that has a control tower frequency listed*.

Now, how does the pilot find out if an airport has a tower frequency or not? Pilots can look up the information for the airport in question via the flight simulator map view. Take a look at the following screenshot in figure 52 of the FS9 map view which shows the control tower frequency 118.10 (labeled on the map as CT) for KCLT (do not confuse this with the CTAF frequency). Also notice that the airport is shown in the color blue representing a towered airport just like on real-life sectional charts.

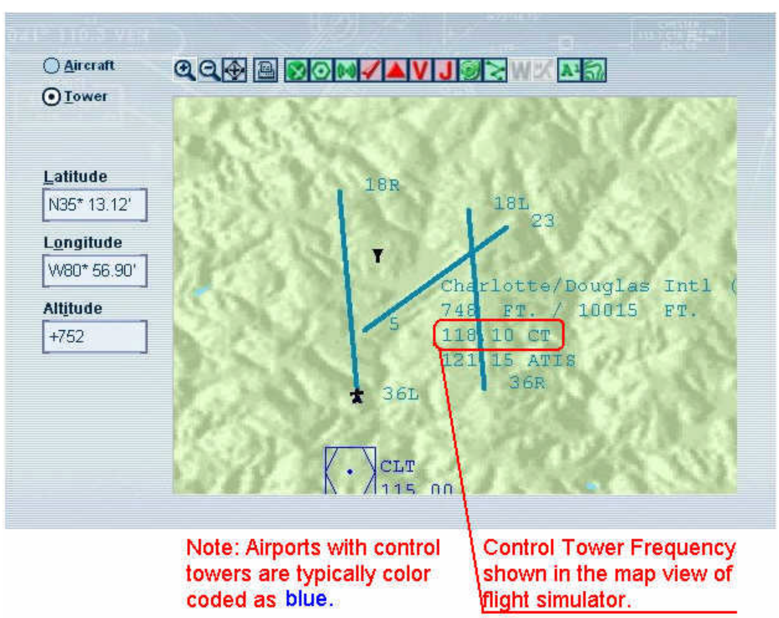


Figure 52 - Map view of a towered airport.

Another way for pilots to find out if an airport has a tower frequency is via the GPS. If a pilot clicks on the nearest (NRST) button on the GPS it will show all airports nearest to the current location of the aircraft. If the aircraft is actually located on an airport you'll notice the first one in the list will be the airport where the aircraft is located.

Figure 53 - GPS view of airports nearest KCLT.

In figure 53 above the aircraft is sitting on runway 36L at KCLT so the first airport listed is KCLT. If the airport has a control tower (and it does in this case) the tower frequency will be listed as shown. As seen in figure 53 there is a control tower depicted in the scenery, but do use that to determine whether the airport is a towered airport. Always use the listed data.

Controllers can easily use FS Navigator to check airport information. Seen here in figure 54 is the tower frequency listed for KDCA Ronald Reagan Washington National airport (a controlled airport).

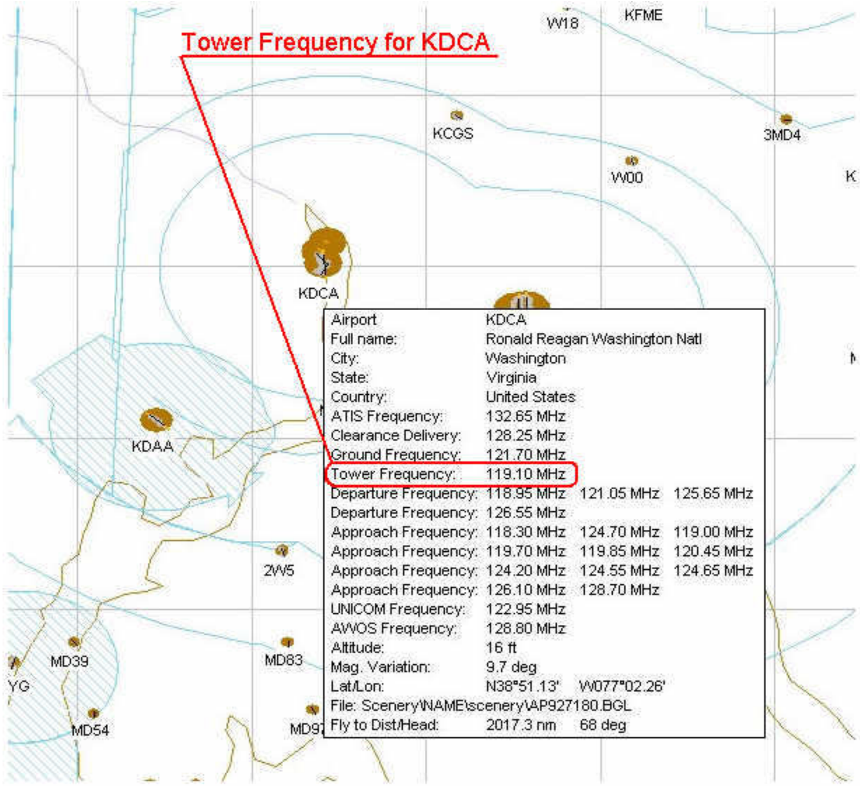


Figure 54 - Tower frequency listed for KDCA (a tower controlled airport).

NON-TOWERED AIRPORTS

A non-towered (uncontrolled) airport is depicted as shown below in figures 55 and 56. Non-towered airports are those without a control tower frequency listed. Typically a CTAF frequency (Common Traffic Advisory Frequency) will be listed, in this case 122.70. Also note that non-towered airports are shown in the color magenta representing a non-towered airport, again just like real-life sectional charts.

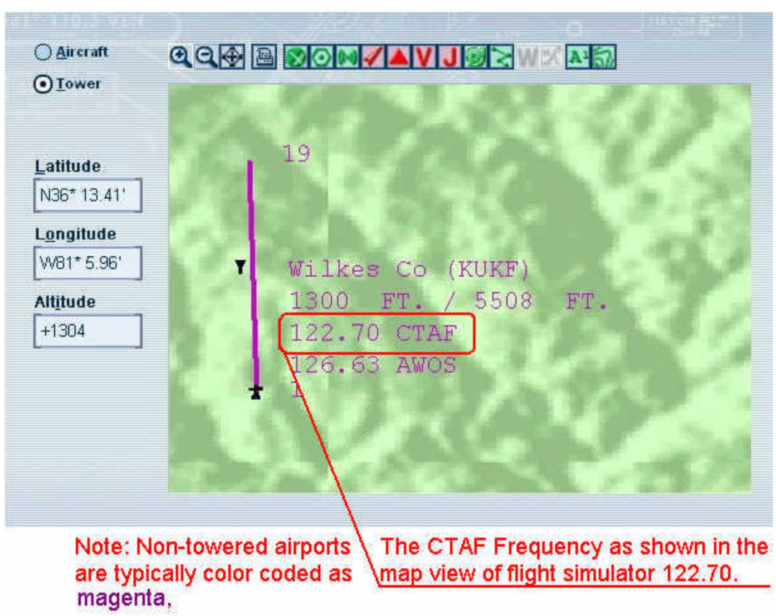


Figure 55 - Map view of a non-towered airport.

Figure 56 - GPS view of a CTAF frequency for a non-towered airport.

Controllers will see similar information for a non-towered (uncontrolled) airport using FS Navigator as shown below in figure 57. KGVE is a non-towered airport because no tower frequency is listed, only a CTAF and UNICOM frequency is listed (in this case they are one in the same, 123.00).

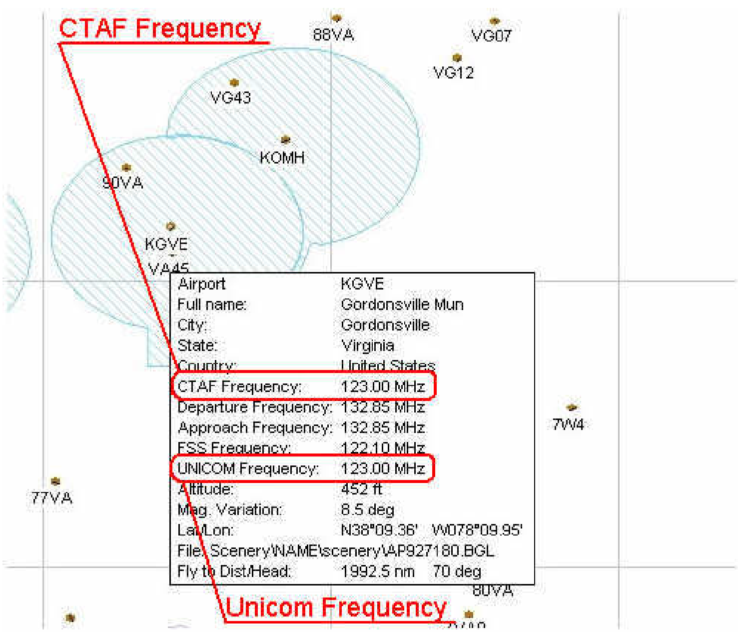


Figure 57 - FS Navigator view of a CTAF and Unicom frequency for KGVE (a non-towered airport).

Many pilots (and controllers) confuse the listed CTAF frequency in flight simulator as a control tower frequency, it is not! CTAF stands for Common Traffic Advisory Frequency typically used at airports *without control towers* for providing airport advisories. *The CTAF may be a UNICOM, Multicom, or FSS frequency as identified in aeronautical publications*.

The simulator *may or may not* list such a CTAF or Unicom frequency at uncontrolled airports. ***Regardless, if the airport does not list a control tower frequency it will be considered uncontrolled for any discussions in this manual.***

ATIS INFORMATION

During VFR or IFR departures pilots can obtain the latest weather (as set within FSHost) a couple of ways. This information would typically be obtained just before requesting taxi from the ground controller, this way the pilot will have the current wind direction and speed, visibility, temperatures (both outside and dew point), and the barometric setting. When the pilot contacts ground they advise which ATIS broadcast identification (in our case it is posted via text) they obtained such as “Foxtrot” shown in figure 58 below. This helps speed up getting you underway because if you don’t advise the ground controller of the ATIS identification received the ground controller will actually stop to read the ATIS information posted to you.

The ATIS information is typically posted under the “Description” of the channel that the ATC1 controller would use (and that typically is the first channel in the frequencies listed on TeamSpeak). In other words you would need to highlight the channel the ATC1 controller is using. As seen in figure 58 below the first channel is highlighted (this would be the channel the ATC1 controller would be using) and when you look under the channel description you can see the ATIS information.

As discussed in the topic about “What ATC Software Needs Today” in chapter 1 it would be great if TeamSpeak provided the capability to allow a simple .wav or .mp3 file to be attached to one channel (frequency) for pilots to tune to and listen to a continuous loop of a prerecorded ATIS message (more like real-life). It is not for the lack of trying mind you, the suggestion has been passed along several times to the folks at TeamSpeak but no response was ever received? It would be a great solution for simulating an ATIS broadcast!

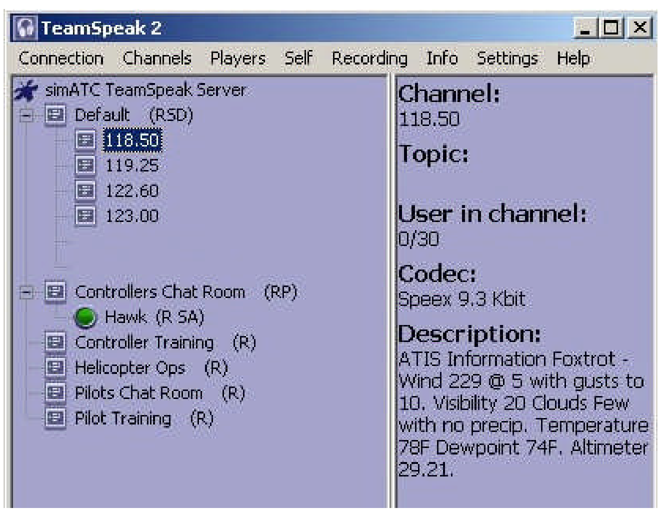


Figure 58 - ATIS Information provided on the first TeamSpeak channel.

In real-life it wouldn’t be unusual for an ATIS broadcast to include the active runway at the airport where the broadcast is given but because the weather in FSHost is “global” and because of the thousands of airports in flight simulator there is no method currently to provide individual ATIS “broadcasts” for each airport, so one ATIS does it for *ALL* airports in this case.

TAXIWAY/RUNWAY SIGNS AND MARKINGS

Airport pavement markings and signs provide information that is useful to a pilot during takeoff, landing, and taxiing. Uniformity in airport markings and signs from one airport to another enhances safety and improves efficiency.

I'll now go over some of the more important signs and markings that virtual pilots may see in scenery. The tower controller and especially the ground controller may issue instructions based on these signs and markings so it is important for virtual pilots to become familiar with them. I'll group these into four areas:

1. Runway Markings.
2. Taxiway Markings.
3. Holding Position Markings.
4. Other Markings.

Markings for runways are white. Markings defining the landing area on a heliport are also white except for hospital heliports which use a red "H" on a white cross. Markings for taxiways, areas not intended for use by aircraft (closed and hazardous areas), and holding positions (even if they are on a runway) are yellow.

There are three types of markings for runways: visual, non-precision instrument, and precision instrument.

Marking Element	Visual Runway	Non-precision Instrument Runway	Precision Instrument Runway
Designation	X	X	X
Centerline	X	X	X
Threshold	X[1]	X	X
Aiming Point	X[2]	X	X
Touchdown Zone			X
Side Stripes			X
[1] On runways used, or intended to be used, by international commercial transports.			
[2] On runways 4,000 feet (1200 m) or longer used by jet aircraft.			

Figure 59 - Runway Marking Elements.

Runway numbers and letters are determined from the approach direction. The runway number is the whole number nearest one-tenth the magnetic azimuth of the centerline of the runway, measured clockwise from the magnetic north. Runway letters, differentiate between left (L), right (R), or center (C), parallel runways, as applicable:

1. For two parallel runways "L" "R".
2. For three parallel runways "L" "C" "R".

The runway aiming point marking serves as a visual aiming point for a landing aircraft. These two rectangular markings consist of a broad white stripe located on each side of the runway centerline and approximately 1,000 feet from the landing threshold (reference figure 60).

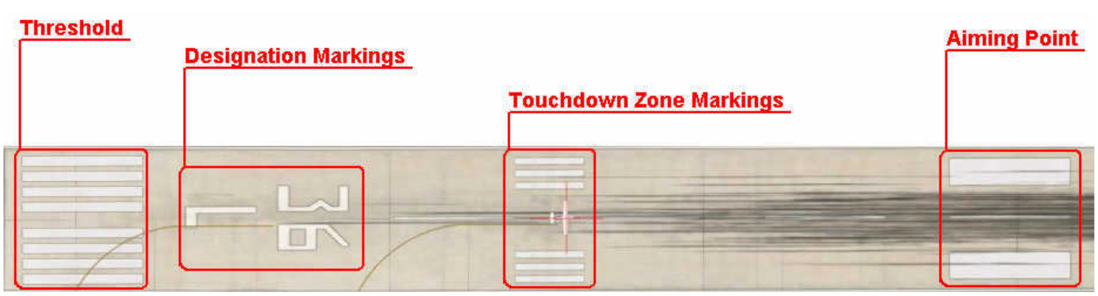


Figure 60 - Precision Instrument Runway Markings (Part 1).

The touchdown zone markings identify the touchdown zone for landing operations and are coded to provide distance information in 500 feet (150m) increments. These markings consist of groups of one, two, and rectangular bars symmetrically arranged in pairs about the runway centerline.

Figure 61 - Precision Instrument Runway Markings (Part 2).

Figure 62 - Precision Instrument Runway Markings (Part 3).

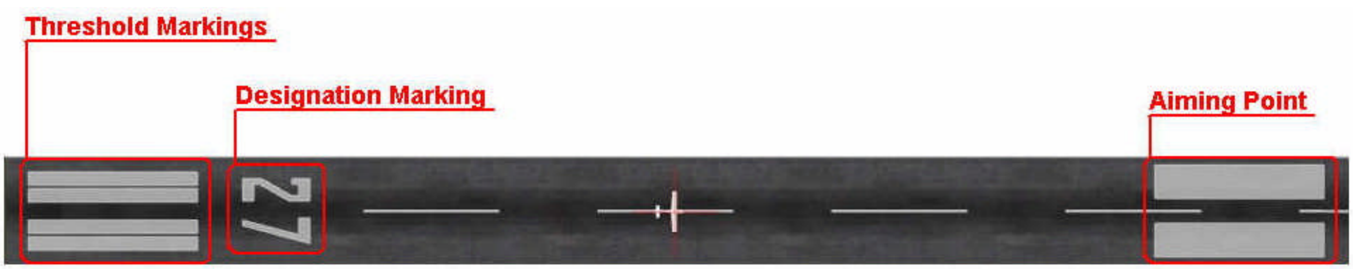


Figure 63 - Non-precision Instrument Runway Markings.

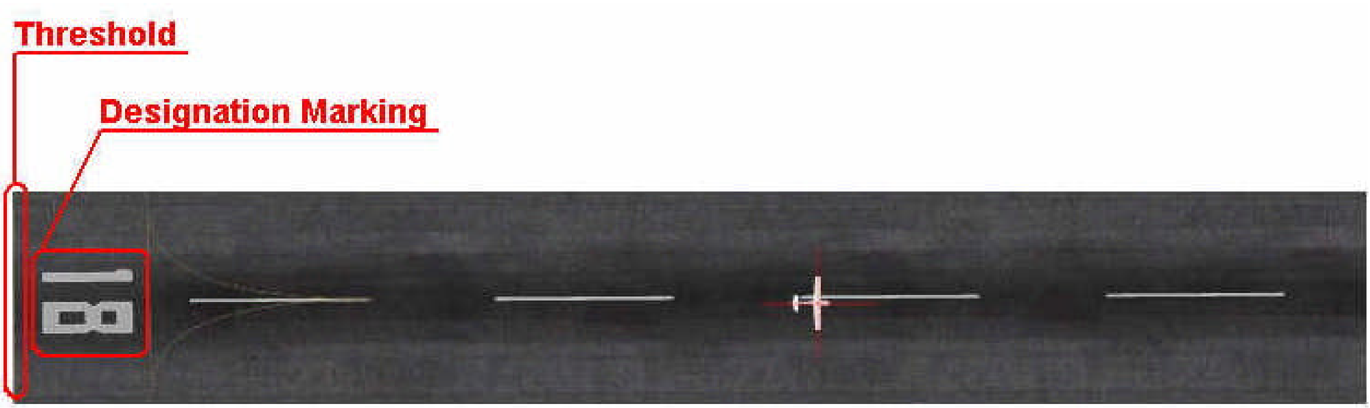
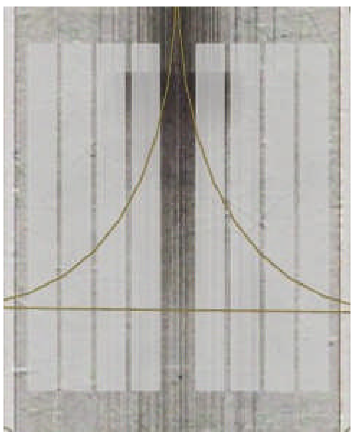


Figure 64 - Visual Runway Markings.

Runway threshold markings come in two configurations. They either consist of ***eight** longitudinal stripes of uniform dimensions disposed symmetrically about the runway centerline*, or *the number of stripes is related to the runway width*. A threshold marking helps identify the beginning of the runway that is available for landing.

Runway Width	Number of Stripes
60 feet (18 m)	4
75 feet (23 m)	6
100 feet (30 m)	8
150 feet (45 m)	12
200 feet (60 m)	16

Figure 65 – The number of runway stripes determine the runway width.



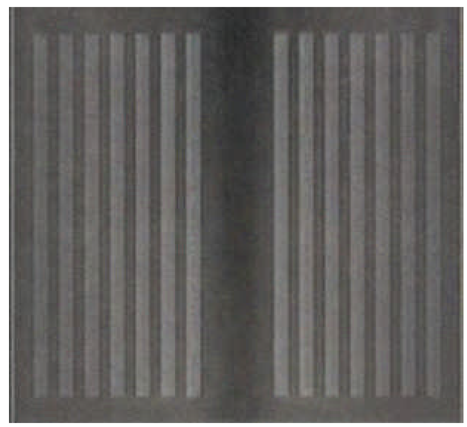


Figure 66 - On the left a 100 foot wide runway, on the right a 150 foot wide runway.

A displaced threshold is a threshold located at a point on the runway other than the designated beginning of the runway. Displacement of a threshold reduces the length of runway available for landings. The portion of the runway behind a displaced threshold is available for takeoffs in either direction and landings from the opposite direction. A ten feet wide white threshold bar is located across the width of the runway at the displaced threshold. White arrows are located along the centerline in the area between the beginning of the runway and displaced threshold. White arrow heads are located across the width of the runway just prior to the threshold bar.

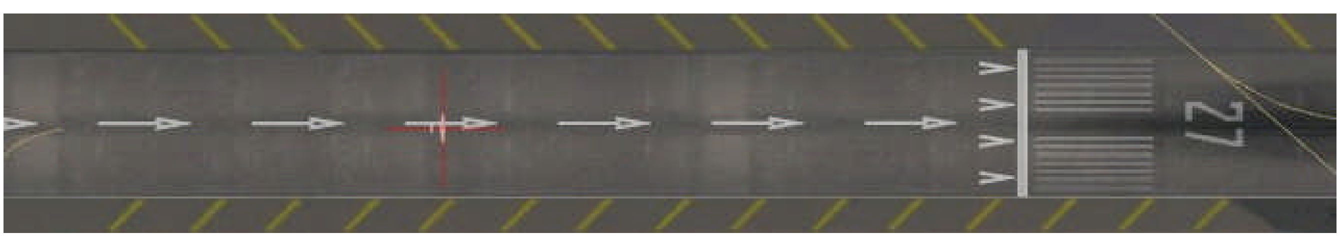


Figure 67 - Displaced Runway Threshold.

Chevron markings are used to show pavement areas aligned with the runway that are ***unusable** for landing, takeoff, and taxiing* and are painted in yellow.

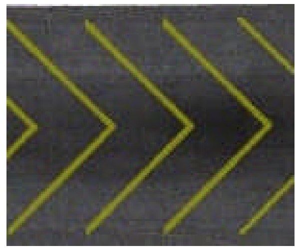


Figure 68 - Chevron markings.

All taxiways should have centerline markings and runway holding position markings whenever they intersect a runway. Taxiway edge markings are present whenever there is a need to separate the taxiway from a pavement that is not intended for aircraft use or to delineate the edge of the taxiway. Taxiways may also have shoulder markings and holding position markings for ILS critical areas, and taxiway/taxiway intersection markings.

Taxiways, holding bays, and aprons are sometimes provided with paved shoulders to prevent blast and water erosion. Although shoulders may have the appearance of full strength pavement they are not intended for use by aircraft, and may be unable to support an aircraft.

Figure 69 - Taxi shoulder markings.

For runways, holding position markings indicate where an aircraft is supposed to stop. They consist of four yellow lines two solid, and two dashed, spaced six or twelve inches apart and extending across the width of the taxiway or runway. The solid lines are *always on the side where the aircraft is to hold* ***(either before getting on or after exiting the runway)***. No part of the aircraft should extend onto or beyond the line on the runway side when holding. Reference figure 70.

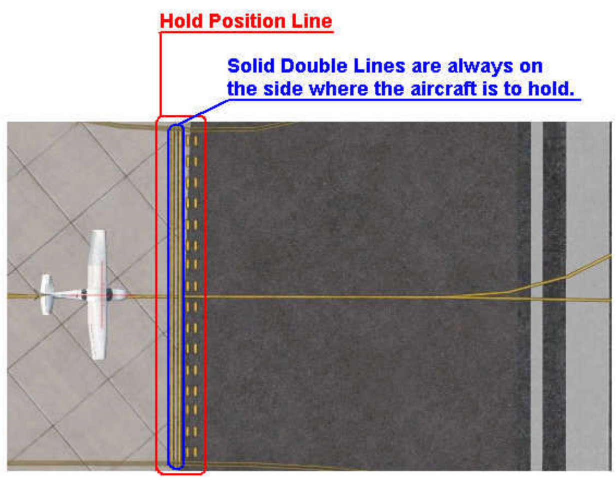


Figure 70 - Hold Position Line

There are three locations where runway holding position markings are encountered.

1. Taxiways.
2. Runways.
3. Runway Approach Areas.

Figure 71 - Runway hold position extending across a holding bay.

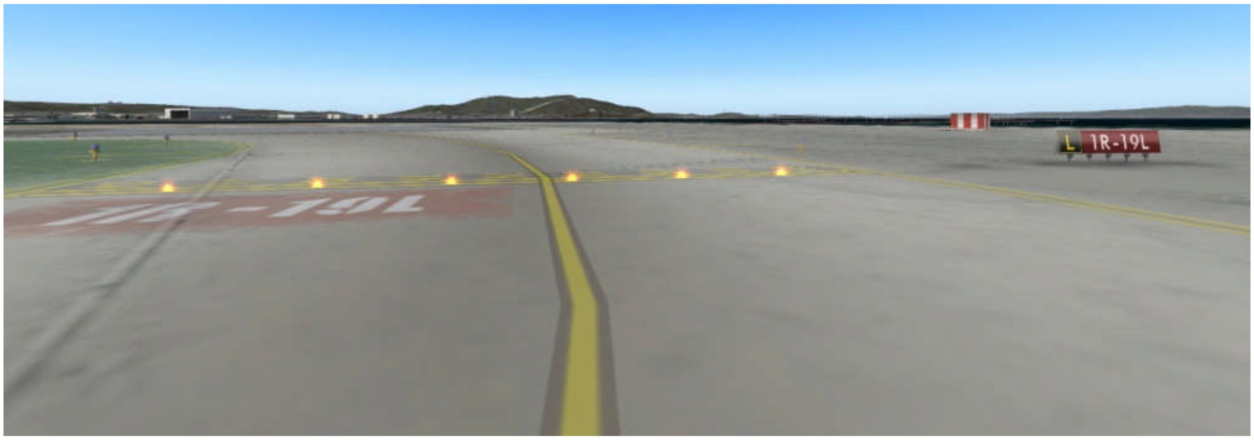


Figure 72 - Taxiway “L” holding position.

When the ILS critical area is being protected (during ILS operations), the pilot should stop so no part of the aircraft extends onto or beyond the holding position marking. When approaching the holding position marking, a pilot should not cross the marking without ATC clearance. When exiting the runway an ILS critical area is not clear until all parts of the aircraft have crossed the applicable holding position marking.

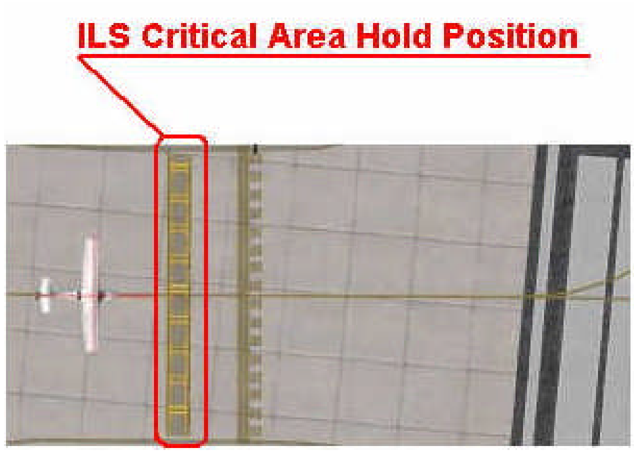


Figure 73 - Holding position markings for ILS critical area.

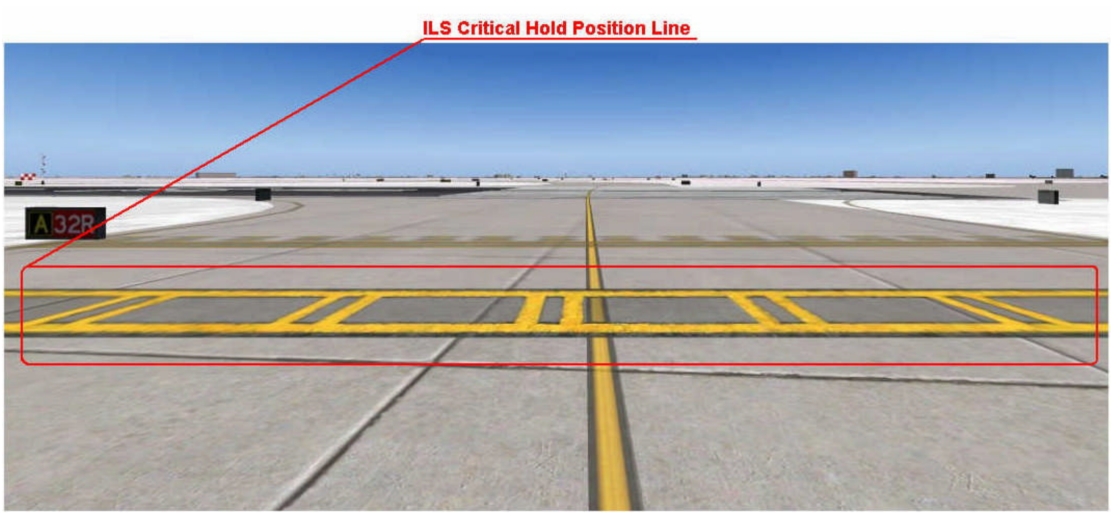


Figure 74 - ILS Critical Hold Position Line.

ILS critical area hold position markings protect the area where ILS signals are transmitted to landing aircraft. The glide slope antennas are normally located near the end of the runway approximately where the touchdown point is on the runway.

Figure 75 - A glide slope antenna array.

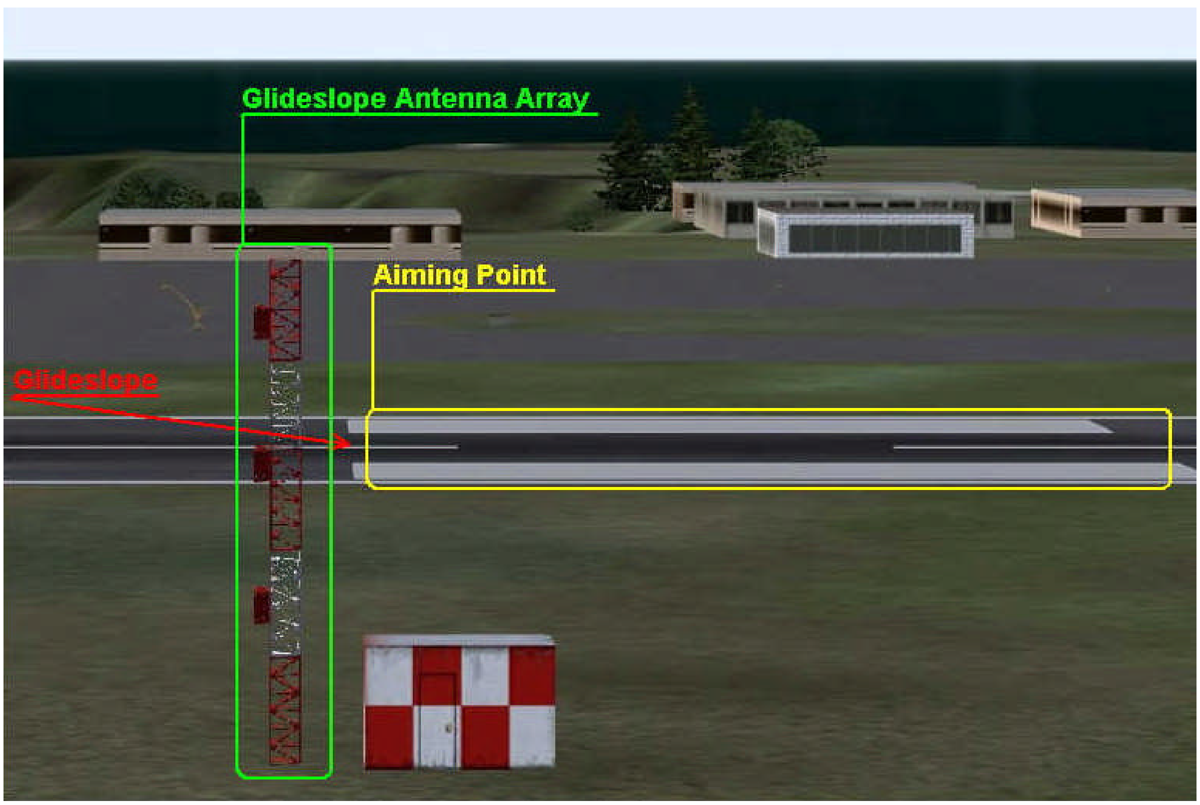


Figure 76 - Glide slope Antenna Array Runway Lineup.

Now when it comes to airport signs there are six types of signs installed on airfields:

1. Mandatory instruction signs.
2. Location signs.

3. Direction signs.
4. Destination signs.
5. Information signs and
6. Runway distance remaining signs.

Mandatory instruction signs have a red background with a white inscription and are used to denote:

1. An entrance to a runway or critical area and;
2. Areas where an aircraft is prohibited from entering.

Runway holding position signs are located at the holding position on taxiways that intersect a runway or on runways that intersect other runways.

Figure 77 - Runway holding position sign.

Figure 78 - Holding position sign at the beginning of a takeoff runway.

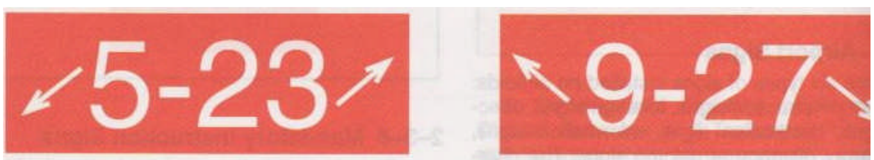


Figure 79 - Holding position sign for a taxiway that intersects the intersection of two runways.

Figure 80 - Holding position sign for an ILS critical area.

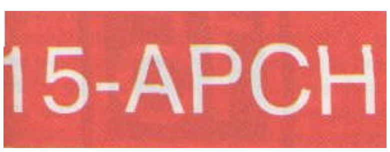


Figure 81 - Holding position sign for a runway approach area.

Figure 82 - Sign prohibiting aircraft entry into an area.

Location signs are used to identify either a taxiway or runway on which the aircraft is located. Other location signs provide a visual cue to pilots to assist them in determining when they have exited an area.

Taxiway location signs have a black background with a yellow inscription and yellow border. The inscription is the designation of the taxiway on which the aircraft is located (typically a letter designator). These signs are installed along taxiways either by themselves or in conjunction with direction signs or runway holding position signs.

Figure 83 - Taxiway location sign.

Figure 84 - Taxiway location sign collocated with runway holding position sign.

Runway location signs have a black background with a yellow inscription and yellow border (reference figure 85). The inscription is the designation of the runway on which the aircraft is located. These signs are intended to complement the information available to pilots through their magnetic compass and typically are installed where the proximity of two or more runways to one another could cause pilots to be confused as to which runway they are on.

Figure 85 - Runway location sign.

Direction signs have a yellow background with a black inscription (reference figure 86). The inscription identifies the designation(s) of the intersecting taxiway(s) leading out of the intersection that a pilot would normally be expected to turn onto or hold short of. Each designation is accompanied by an arrow indicating the direction of the turn. Direction signs are normally located on the left prior to the intersection. When used on a runway to indicate an exit, the sign is located on the same side of the runway as the exit.

Figure 86 - Direction sign for runway exit.

Figure 87 - Direction Sign for Exiting Runway on Taxiway "A".

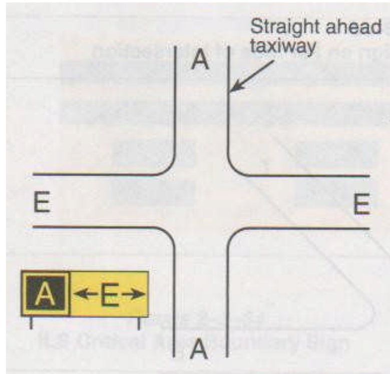


Figure 88 - Direction sign array for a simple intersection.

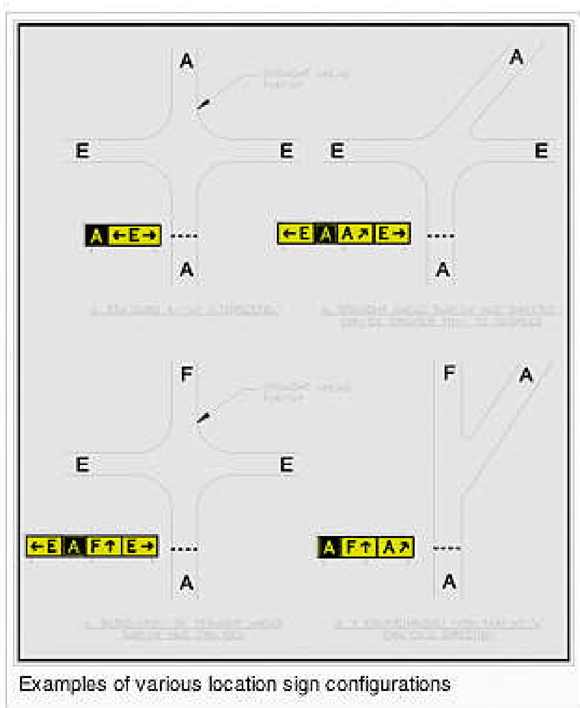


Figure 89 – Direction sign arrays demonstrating possible taxiways.

Destination signs have a yellow background with a black inscription indicating a destination on the airport. These signs always have an arrow showing the direction of the taxiing route to that destination. When the arrow on the destination sign indicates a turn, the sign is located prior to the intersection.

Figure 90 - Destination sign for a military area.

Figure 91 - Destination sign for common taxiing route to two runways.

Figure 92 - Destination sign for different taxiing routes to two runways.

Information signs have a yellow background with a black inscription. They are used to provide the pilot with information on such things as areas that cannot be seen from the control tower, applicable radio frequencies, and noise abatement procedures (None shown here).

Runway distance remaining signs have a black background with a white numeral inscription and may be installed along one or both side(s) of the runway. The number on the signs indicates the distance (in thousands of feet) of landing runway remaining.

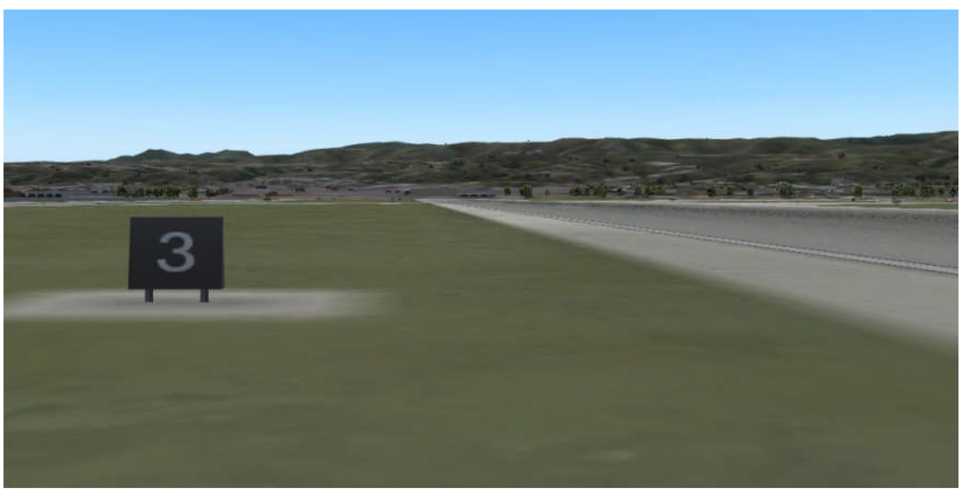


Figure 93 – Runway remaining sign showing 3000 feet of runway remaining on a KSFO runway.

TAXI OPERATIONS

At towered (controlled) airports the ground controller can provide *progressive taxi* instructions to the pilot. This is for pilots that either don’t have the necessary airport charts or are unfamiliar with the airport (don’t forget about the possible scenery differences we have previously discussed). It is vitally important the pilot *NOT* change to the tower frequency until *stopping at the hold short point for the active runway to be used for takeoff* or *unless otherwise advised by the ground controller*. This way the ground controller can advise the pilot of any ground traffic conflicts while proceeding to the runway for takeoff.

If you must cross another runway on the way to the active *STOP at the appropriate hold short line before crossing* unless already cleared by the ground controller. See figures 94 and 95 below.

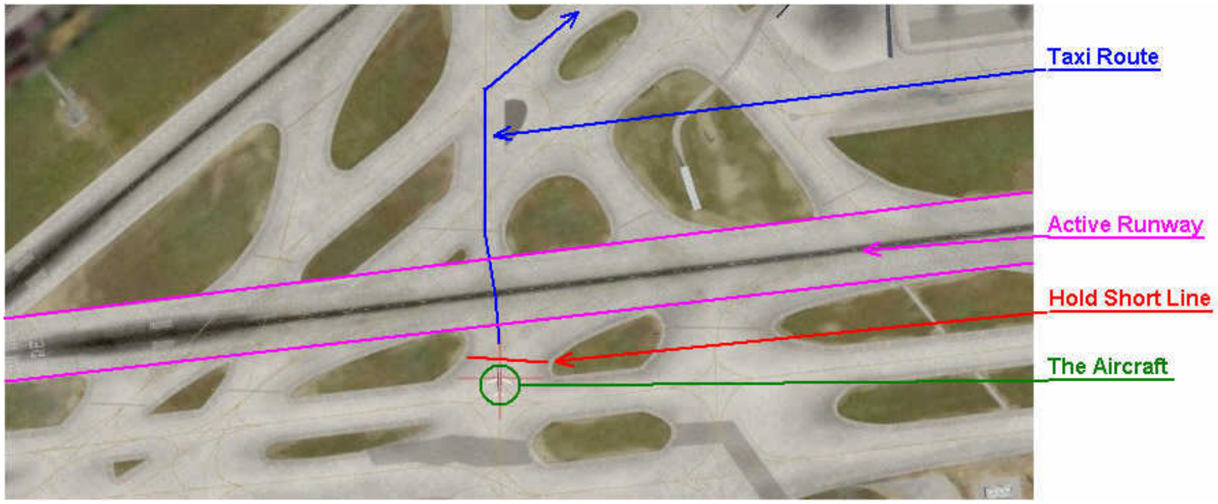


Figure 94 - Crossing a runway during taxi operations.

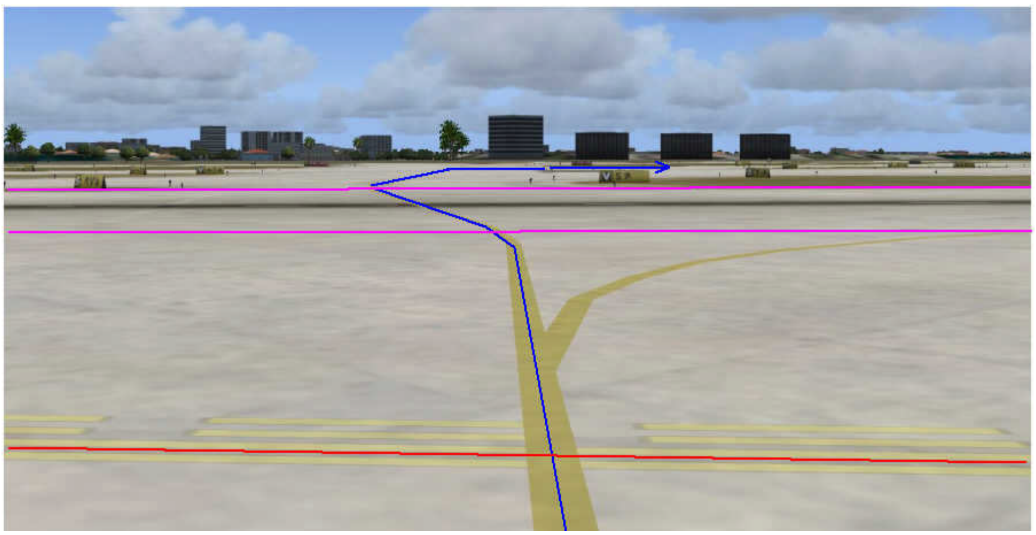


Figure 95 - This is figure 94 from the cockpit window perspective.

Remember the tower controller "owns" the runway(s). *NEVER cross or position your aircraft on a runway until cleared* by the appropriate controller (either ground or tower). Hell has no fury like a controller gone wild <grin>!

TAXIWAYS AT UNCONTROLLED AIRPORTS

It is a good time to note, due to construction costs, taxiways at uncontrolled airports are not always built to reach the runway threshold (as depicted by routes A or B in figure 96 below) allowing an aircraft to safely taxi without using the active runway. At most smaller airports due to the lack of full taxiways the pilot will be required to "back taxi" to the end of a runway on the runway itself turning 180 degrees once reaching the end to line up for takeoff as depicted by C or D in figure 96.

Figure 96 - Taxi routes and "Back Taxi" routes.

It should be noted that it is possible to conduct back taxi operations even at towered airports or larger airports. Some runways have turn around areas near the end of the runway to accommodate larger aircraft having to do a 180 degree turn due to back taxi operations.

THINGS TO DO WHEN HOLDING SHORT

Here are some nice to know points for the pilot holding short for takeoff…just before taxing onto the runway it is common practice for the pilot to turn on the transponder, *including Mode C altitude reporting* (reference figures 97 and 98 below). The reason for keeping the transponder turned off while not airborne is because the resulting signal creates a nice little aircraft blip on the radar scope that will cause extreme "clutter" on the scope in the general area of the airport. So to minimize this pilots are trained to turn the transponder on just before takeoff and to turn it off just after landing.

Figure 97 - Boeing 737 transponder unit.

If you're wondering about the traffic/resolution advisory (TA/RA) position on the transponder unit above, it is a position that activates the Traffic Alert and Collision Avoidance System (TCAS) units on aircraft equipped with these units, I'll discuss more about these later.

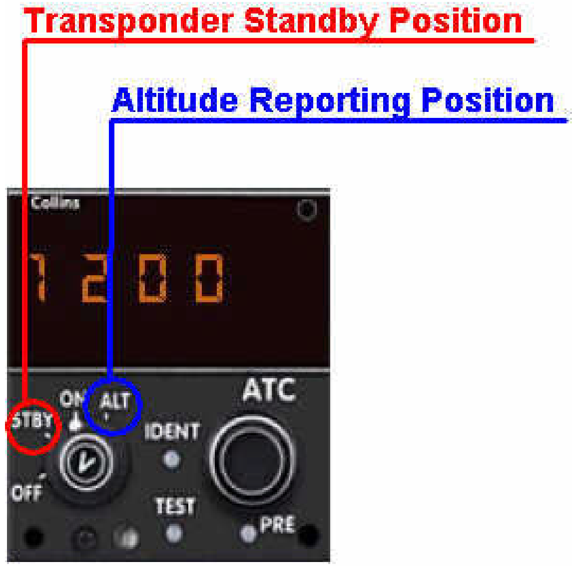


Figure 98 - Beech King Air transponder unit with no TCAS capability.

If you have ever watched the AI aircraft in the flight simulator from the ground or in a suspended state over an airport during night time operations you'll see that they turn on the runway lights just before taxing onto the runway. Experienced virtual pilots know that taxing with the runway lights turned on (at night) can be annoying because it makes it hard to see the runway (they are quite bright) so all that are needed are the taxiway lights (reference figures 99 and 100).

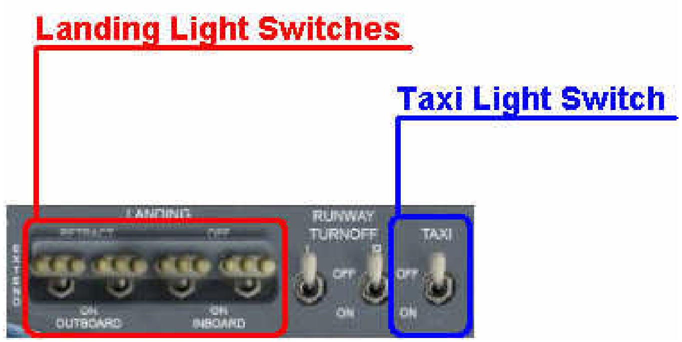


Figure 99 - Boeing 737 light switches.

Figure 100 - Beech King Air light switches.

The same goes for strobe lights (at night) especially on smaller aircraft. In real-life strobe lights are annoying during taxi operations due to the reflection off the ground. Most pilots will wait until the aircraft is positioned for takeoff or just after going airborne to turn on the strobe lights.

It should be noted the opposite is true during landing. They will turn off the strobe and landing lights and the transponder as soon as they clear the runway. Note that on smaller aircraft no taxi light may be available and the landing light *is* used for taxi operations.

AIRPORT TRAFFIC PATTERNS

FAR 91.126(b) specifies the direction of turns when approaching to land at an airport without an operating control tower. Each pilot of an airplane must make all turns of that airplane to the left unless the airport displays approved light signals or visual markings indicating that turns should be made to the right, in which case the pilot must make all turns to the right. I have never seen any author depict an airport as described with a right-handed traffic pattern so for simplicity I'd stick to left-handed traffic patterns for our discussions. So whether it is a single runway airport or a multi-runway airport, the airport traffic pattern to be visualized for the designated landing runway should be a left-handed pattern as depicted in figure 101 below.

The various components of a standard left-handed traffic pattern have been named to clearly identify each. You can see the various named parts of a left-handed airport traffic pattern in figure 101 below. They are in order of sequence as follows:

1. Upwind Leg
2. Crosswind Leg
3. Downwind Leg
4. Base Leg
5. Final Approach
6. Departure

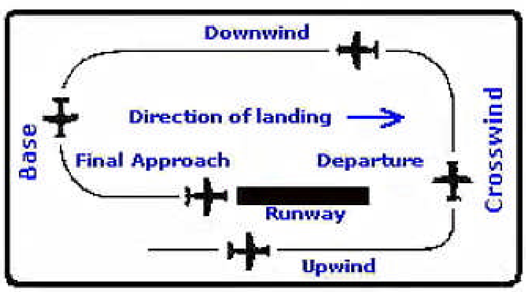
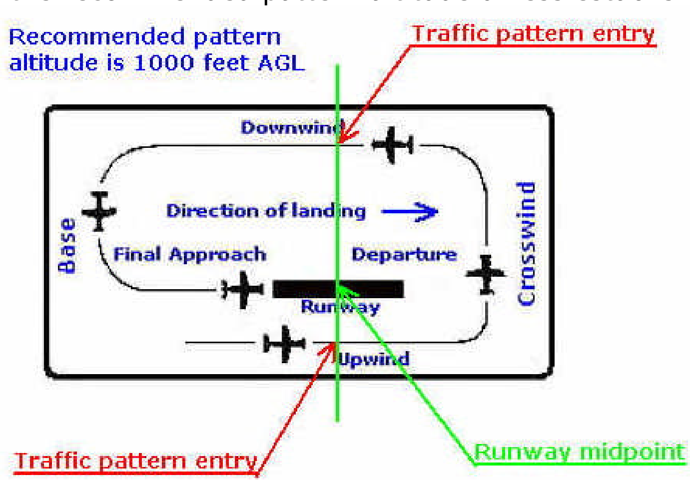


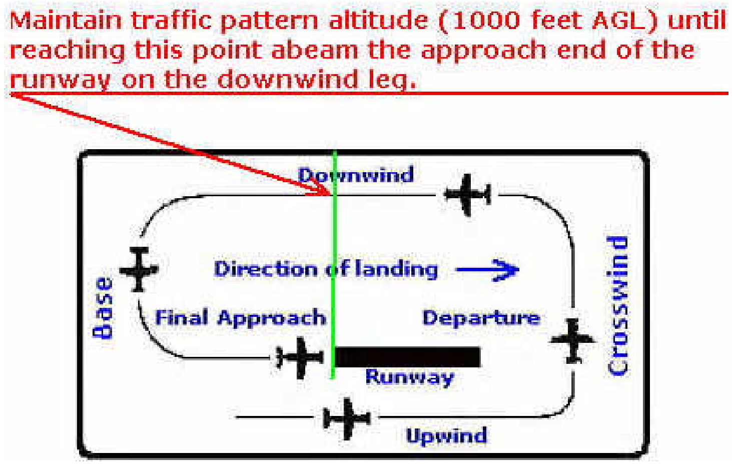
Figure 101 - Components of a traffic pattern.

In the AIM 4-3-3 there are *written* examples given as keys to traffic pattern operations which I'll provide a graphic representation for each here:

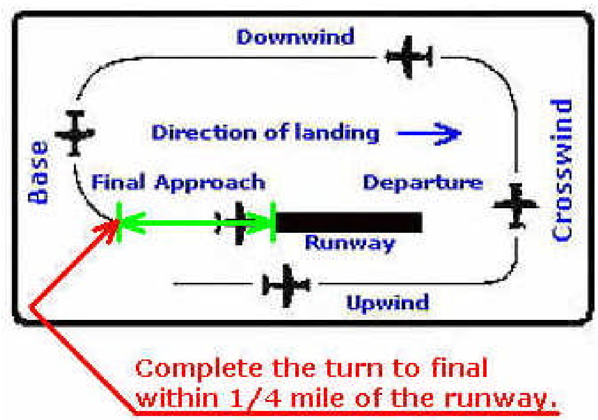
1. Enter the pattern in level flight, abeam the midpoint of the runway, at pattern altitude (1,000 feet AGL is the recommended pattern altitude unless established otherwise).



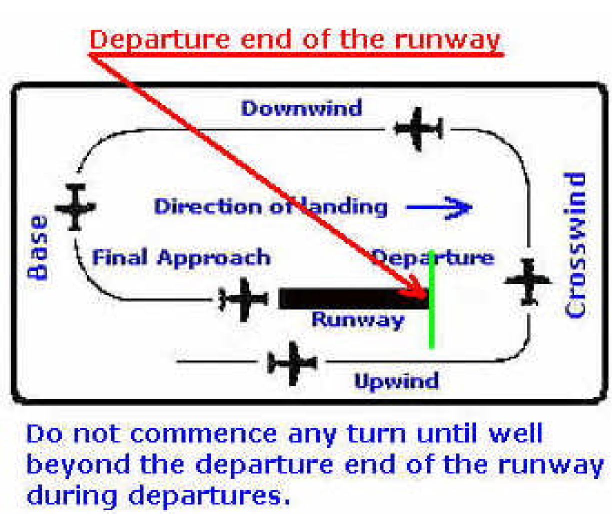
2. Maintain the pattern altitude (1,000 feet) until abeam the approach end of the landing runway on the downwind leg before continuing descent further for landing.



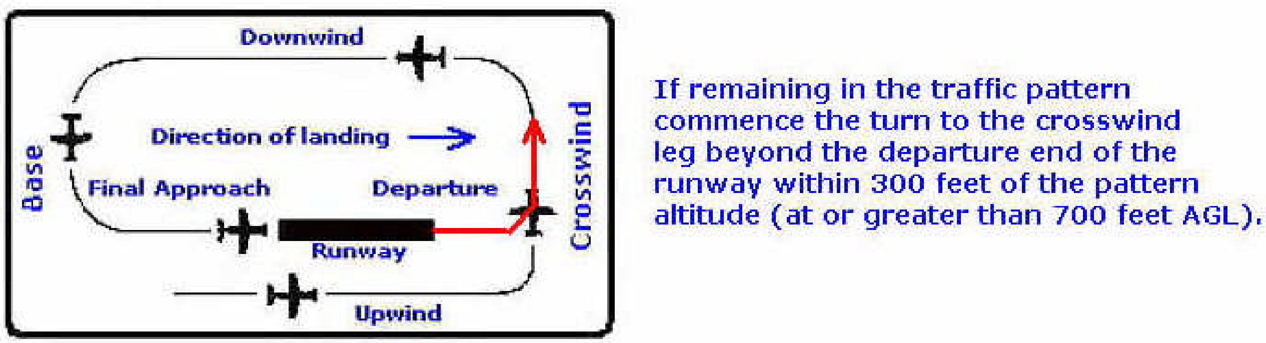
3. Complete the turn to final at least ¼ mile from the runway.



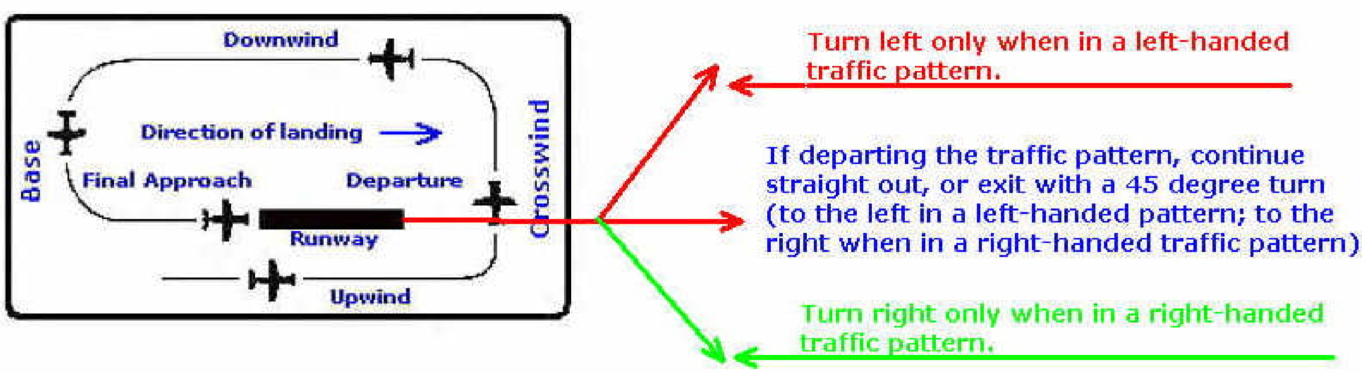
4. Continue straight ahead until beyond the departure end of the runway.



5. If remaining in the traffic pattern, commence the turn to the crosswind leg beyond the departure end of the runway within 300 feet of the pattern altitude.



6. If departing the traffic pattern, continue straight out, or exit with a 45 degree turn (to the left when in a left-handed traffic pattern; to the right when in a right-handed traffic pattern) beyond the departure end of the runway, *after* reaching pattern altitude (1,000 feet).



Note that this guidance for traffic patterns at uncontrolled airports would also apply to runways at controlled airports when a controller is vectoring a pilot for a visual landing. For instance, the controller will normally vector the pilot until the pilot has visual contact with the airport environment. Then the controller might instruct the pilot to enter a left downwind for runway 09. At that point the pilot pretty much follows the rules for the traffic pattern as given above. At some point along the base leg or final approach the controller will provide the pilot a final landing clearance.

Now you should have a better idea on how to approach and enter the traffic pattern for an uncontrolled (or controlled) airport during a VFR landing. As listed above it is very important for the VFR pilot to make the required calls on the Unicom frequency at an uncontrolled airport. Normally only one frequency will be allocated on TeamSpeak for this purpose but that is okay. It is not abnormal to hear other pilots at nearby uncontrolled airports making similar calls while in another airports traffic pattern. You only need to be concerned with aircraft that are in the immediate vicinity of the airport area in which you are operating your aircraft.

It should be noted that the listed reporting points are only a minimum requirement. It never hurts to provide extra information to other pilots as long as that information will not cause confusion. Always be brief and clear about your movements and intentions.

I provide in chapter 6 a complete scenario for pilot/controller communications during VFR flights. The more you go over the scenarios the better your understanding will be to apply the basic guidance given.

VERTICAL AIRSPACE (ALTITUDES)

We have already discussed a few things about airspace where it concerned airspace around various types of airports. But what about the vertical airspace, in other words the altitudes, is there limitations or restrictions to these? The answer is very much yes. The real-world pilot is faced with a complex maze of prescribed altitudes but not all those are necessary for online multiplayer activities, so here I'll explain the minimum vertical requirements to keep things simple but still provide a degree of realism as experienced in the real world of aviation.

VFR ALTITUDES
Located in the AIM is a table for VFR Altitudes (see 3-1-2). This table sets requirements for selecting altitudes for VFR flights. VFR pilots typically fly at altitudes of thousands plus 500 such as 6500, 7500, 15,500 when below 18,000 feet (don't forget for virtual purposes everything at or above 18,000 feet up to 60,000 feet is classified as Class A airspace and falls under ATC control so VFR flights are prohibited between these altitudes). In addition depending on the direction of travel the altitude is divided further, for instance, VFR flights flying from the west to east (0 to 179 degrees inclusive) would choose the odd thousands plus 500 feet such as 5500, 7500, and 9500 and so on. VFR flights flying from east to west (180 to 359 degrees inclusive) would choose the even thousands plus 500 feet such as 6500, 8500, and 12500 and so on.

IFR ALTITUDES
Located in the AIM is a table for IFR Altitudes (see 3-3-1). This table sets requirements for selecting altitudes for IFR flights. IFR pilots typically fly at altitudes of thousands such as 6000, 7000, 25000 and so on. In addition IFR flights flying from the west to east (0 to 179 degrees inclusive) would choose the odd thousands such as 5000, 7000, and 9000 and so on. IFR flights flying from east to west (180 to 359 degrees inclusive) would choose the even thousands such as 6000, 8000, and 12000 and so on.

REDUCED VERTICAL SEPARATION MINIMUM (RVSM)
Recently new rules have been introduced for real-life operations in upper altitudes called "Reduced Vertical Separation Minimum (RVSM)" airspace. In a nutshell RVSM is airspace where ATC separates aircraft by a minimum of 1000 feet vertically between 29000 feet (flight level 290) and 41000 feet (flight level 410) inclusive. RVSM is *special qualification* airspace meaning the operator (pilot) and the aircraft must be certified for operations in RVSM airspace. RVSM is basically a way to provide more efficient use of the crowed skies. Again, this may be more than what the flight simulator audience is ready to absorb right now so I'll leave it to individual ATC services to decide whether they'll use these. The standard altitude selections explained in VFR and IFR altitudes keep it simple and are easily remembered, sufficient for virtual activities.

Below in figure 102 is a comparison of the standard vertical separation limits (above 18,000 feet and between flight levels 290 and 410) and the equivalent use of RVSM altitudes. You can see that the main difference is the additional flight altitudes squeezed in between the other layers allowing for more air traffic between these altitudes. This is the reason for special pilot qualifications and aircraft equipment as the tolerance is much tighter and requires more vigilance to provide safe separation of en route aircraft.

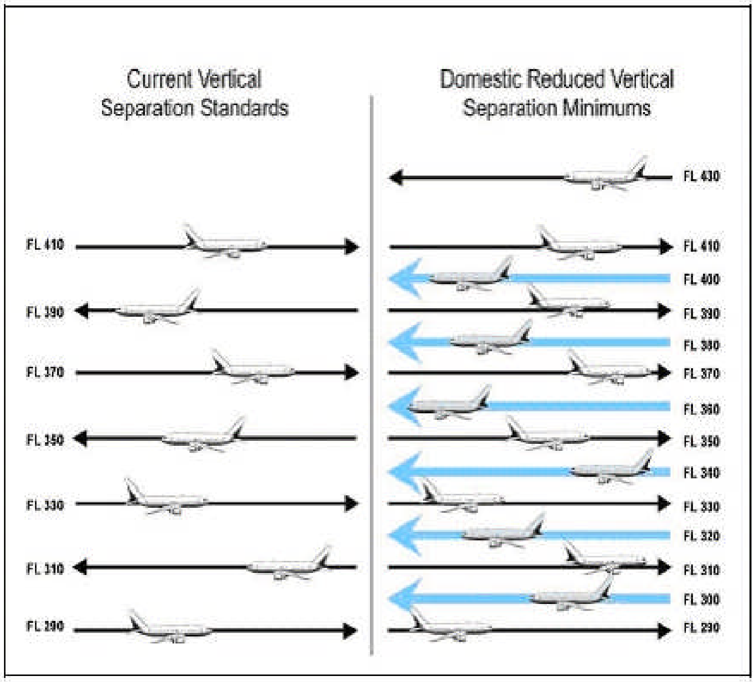


Figure 102 - Comparasion of standard vertical standards and RVSM standards.

THE AIRSPACE WEATHER ELEMENT

There is a changing element present within all airspace that becomes a major factor in determining which pilots are qualified to operate within any given airspace, the element is weather. When it comes to weather two types of flight rules have been established, visual flight rules (VFR), and instrument flight rules (IFR).

Visual flight rules pertain to pilots qualified to fly when the weather within an airspace in which the pilot is operating an aircraft meets specific requirements of visibility and the ability for the pilot to stay clear of clouds. For instance, VFR pilots are allowed to fly when the reported visibility is at 3 statue miles or greater and by staying clear of all clouds. Instrument flight rules pertain to pilots qualified to fly when the weather within an airspace in which the pilot is operating an aircraft meets specific requirements to fly the aircraft by instruments through non-threatening weather (that is weather considered safe to fly through). Smart pilots will stay well clear of thunderstorms and squall lines unless they intend to crash and burn <grin>.

So, the rule is simple for virtual pilots, when the weather set in FSHost simulates visibilities less than 3 statue miles, they must be able to operate the aircraft by the instruments, including navigation and approaches to airports, without possibly any visual reference to the ground or surrounding landmarks as would a VFR pilot. I'll discuss the visibility issue further along. Also I provide training within this manual for virtual pilots to become familiar with all aspects of instrument flight and landings.

We have now discussed the primary considerations for airspace. The differences that determine controlled and uncontrolled airspace, how to determine when airports are towered (controlled) airports or non-towered (uncontrolled) airports, use of the airspace layers referenced by altitude, and how weather present within the airspace affects pilot qualifications and requirements.

NOTES ABOUT FLYING BELOW 10,000 FEET

At this point let me mention some real-life common practices that occur when aircraft fly *below 10,000 feet*. If the aircraft is flying below 10,000 feet *do not exceed 250kts* unless cleared by a controller to do so. Also, pilots should *ensure the landing lights remain turned on* (see and be seen is the motto here). If you're in a general aviation aircraft (that probably won't reach 10,000 feet or above) the landing lights are typically *turned off after safely leaving the airport area.* The reverse is true when landing a general aviation aircraft, turn the lights on well before reaching the airport.

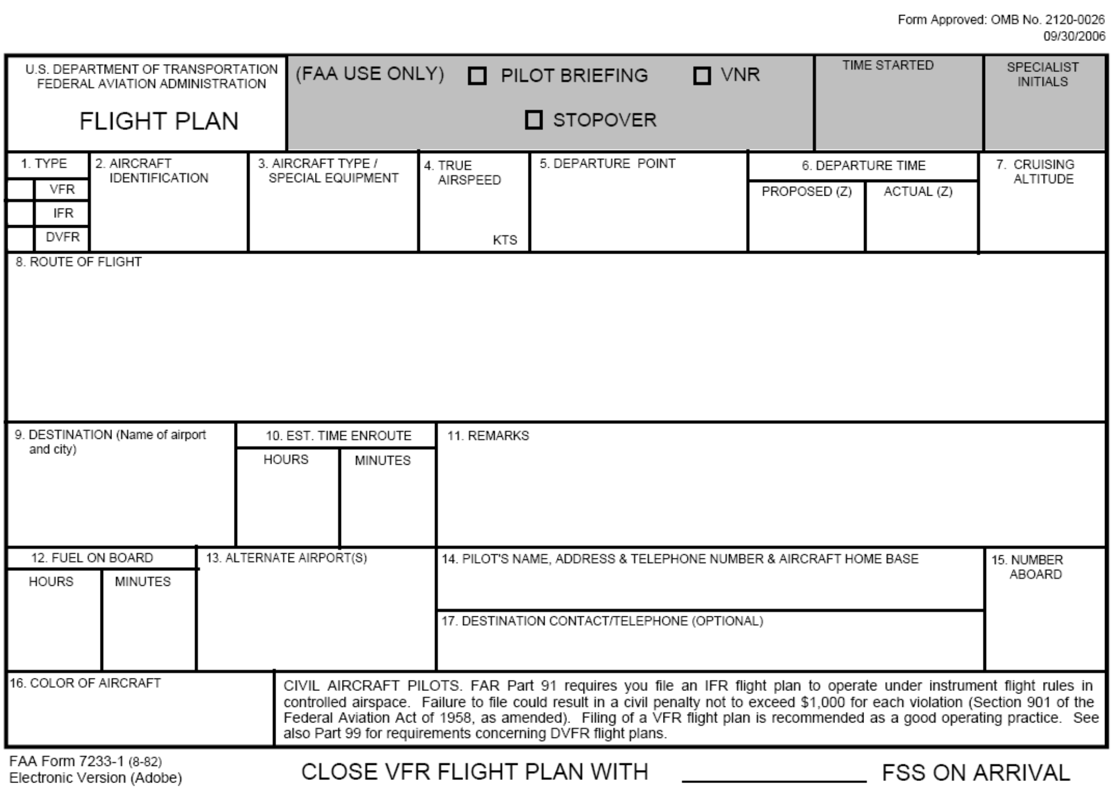
In real-life there is an exception for landing lights and strobes while flying in IMC conditions; *if the landing lights or strobes are turned on while moving along inside clouds at night it typically proves to be very distracting and can ruin a pilot's adjustment to night vision like flash bulbs going off without your eyes shut, so many pilots opt to turn them off until established on the ILS localizer or glide slope (the reverse applies for takeoffs)*. The same goes for *strobe lights, typically turned on just after take-off to prevent distractions by the reflection off the ground (and the reverse applies for landings)*.

FLIGHT PLANS

Flight plans are the life blood of aircraft movement. They tell air traffic controllers all about a flight from point A to point B and even possibly point C (as applies to IFR alternate airports). It spells out the route of the flight and the expected cruise altitude. It provides reassurance to those involved in these flights that if they don't show up at their destination a search will be initiated to locate them. It tells all concerned how many "souls" are on board, how much fuel was loaded, what type of flight is being conducted (such as VFR or IFR), the aircraft identification and type, the departure time and estimated time en route, even the color of the aircraft, and finally the pilots name. Flight plans play an important role both for the virtual VFR and IFR pilot. In the multiplayer environment flight plans can in many ways make the controllers job a breeze or a real pain. I'll explain why and how to do it in a manner that can benefit both pilot and controller during online play.

THE FAA FLIGHT PLAN FORM EXPLAINED

To better understand filing either a VFR or IFR flight plan let's take a close look at the FAA flight plan form itself as shown below in figure 103 by breaking down the information blocks using only those most suited for virtual flight simulations.


Form Approved: OMB No. 2120-0026 09/30/2006

U.S. DEPARTMENT OF TRANSPORTATION FEDERAL AVIATION ADMINISTRATION

FLIGHT PLAN

(FAA USE ONLY) PILOT BRIEFING VNR STOPOVER | TIME STARTED | SPECIALIST INITIALS

1. TYPE: VFR, IFR, DVFR
2. AIRCRAFT IDENTIFICATION
3. AIRCRAFT TYPE / SPECIAL EQUIPMENT
4. TRUE AIRSPEED KTS
5. DEPARTURE POINT
6. DEPARTURE TIME: PROPOSED (Z), ACTUAL (Z)
7. CRUISING ALTITUDE
8. ROUTE OF FLIGHT
9. DESTINATION (Name of airport and city)
10. EST. TIME ENROUTE: HOURS, MINUTES
11. REMARKS
12. FUEL ON BOARD: HOURS, MINUTES
13. ALTERNATE AIRPORT(S)
14. PILOT'S NAME, ADDRESS & TELEPHONE NUMBER & AIRCRAFT HOME BASE
15. NUMBER ABOARD
17. DESTINATION CONTACT/TELEPHONE (OPTIONAL)
16. COLOR OF AIRCRAFT

CIVIL AIRCRAFT PILOTS. FAR Part 91 requires you file an IFR flight plan to operate under instrument flight rules in controlled airspace. Failure to file could result in a civil penalty not to exceed $1,000 for each violation (Section 901 of the Federal Aviation Act of 1958, as amended). Filing of a VFR flight plan is recommended as a good operating practice. See also Part 99 for requirements concerning DVFR flight plans.

FAA Form 7233-1 (8-82) Electronic Version (Adobe)

CLOSE VFR FLIGHT PLAN WITH _______________ FSS ON ARRIVAL

Figure 103 - The FAA Flight Plan form 7233-1.

The numbers shown here correspond to the actual block numbers on the form:

1. Indicate whether the flight plan is VFR or IFR.
2. Enter the complete aircraft identification including the prefix "N" as required.
3. Enter the aircraft type and special equipment.
5. Departure Point.
7. Cruising Altitude.
8. Route of Flight.
9. Destination.
13. Alternate Airport.

Number 1 indicates whether the flight will be conducted under visual flight rules (VFR) or by instrument flight rules (IFR). In the virtual world DVFR is not important.

For virtual operations each ATC service will have guidelines on the aircraft identification to be used (**Number 2**). They may allow users to have any identification they like, they may require the use of the player's virtual airline identification, or they may require an actual identification such as N5018R for a general aviation aircraft or American Airlines Flight 1462 (abbreviated as AA1462). Be sure to follow the appropriate guidelines for the service you use.

Besides ATC knowing the type aircraft a pilot is using, it is also important to describe certain equipment that is available and will be used on the aircraft (**Number 3**). In the real-world pilots might indicate on the flight plan "Cessna 172/U" (as indicated at the bottom of the form above this is a 4096 Code Transponder) but in laymen's terms means there is a transponder onboard with mode C capability (altitude reporting). In the virtual world FS Navigator always reports the altitude of connected aircraft so it doesn't make much sense to put this on a virtual flight plan unless you just want to simulate it, but something that may be very important for virtual controllers to know is whether the pilot plans on using a flight management computer (FMC) to control the aircraft during the virtual flight (I'll discuss this in detail within another chapter). You can list an FMC as equipment here in the same fashion. Example: B734/FMC (734 is an abbreviated way of indicating a B737-400, if not sure just type in B737/FMC).

Number 5 is the departure ICAO, a four letter identifier for the airport of departure such as KCLT. Do not abbreviate this identifier by dropping the first character such as CLT. That first character usually indicates the country of origin and can determine the difference with duplicates around the world (in other words there may be several CLT identifiers around the globe with only the first character to distinguish between them). This is important when controllers do a search for it.

Number 7 is used for indicating the cruising altitude for the flight and is determined as follows.

As previously mentioned pilots that are planning a VFR flight should indicate what altitude will be used en route as the cruising altitude. The VFR pilot has the flexibility to change this altitude during the flight at any time (because they may need to avoid weather or clouds to remain in visual meteorological conditions (VMC). If the VFR pilot changes altitudes en route an appropriate altitude should still be selected based on the following guidelines:

Located in the AIM is a table for VFR Altitudes (see 3-1-2). This table defines the altitudes that VFR pilots should file for a cruise altitude during their flight in odd or even thousands plus 500 feet. This requirement has been modified just slightly to better suit multiplayer activities.

1. If your planned route of flight (magnetic course/ground track) will be between 0 degrees and 179 degrees inclusive and you will be flying below 18,000 feet mean sea level (MSL) then you should select altitudes in odd thousands MSL plus 500 feet (3,500; 5,500; 7,500; etc.)

2. If your planned route of flight (magnetic course/ground track) will be between 180 degrees and 359 degrees inclusive and you will be flying below 18,000 feet mean sea level (MSL) then you should select altitudes in even thousands MSL plus 500 feet (4,500; 6,500; 8,500; etc.)

Pilots that are planning an IFR flight must decide what altitude to request from ATC for their cruising altitude. Unlike the VFR pilot who has the ability to decide exactly what altitude they will use within the parameters for VFR altitudes and the ability to change the altitude during the flight at will, IFR pilots must request an altitude set aside for IFR flight that will be approved by ATC for the flight planned and then fly the altitude assigned. Any change in altitude must be requested from ATC.

Located in the AIM is a table for IFR Altitudes (see 3-3-1). This table defines the altitudes that IFR pilots should request for a cruise altitude during their flight in odd or even thousands. This requirement has been modified just slightly to better suit multiplayer activities.

1. If your planned route of flight (magnetic course/ground track) will be between 0 degrees and 179 degrees inclusive then you should select altitudes in odd thousands MSL (3,000; 5,000; 7,000; etc.)

2. If your planned route of flight (magnetic course/ground track) will be between 180 degrees and 359 degrees inclusive then you should select altitudes in even thousands MSL (4,000; 6,000; 8,000; etc.)

Number 8 is used to record the "Route of Flight". There is a method for filling out this block so as to keep the en route portion of the flight properly formatted. Many pilots use various characters to separate each fix but as stated the separator should be nothing more than a space. There are also rules about how to simplify the information provided in this block to keep it from being overly complicated and brief. The FAR/AIM provides guidance on this and I'll try to present a simplified set of guidelines shortly.

Number 9 is the destination ICAO, a four letter identifier for the destination airport. Use the same guidelines as provided above for block number 5.

Last, is the alternate airport ICAO (**Number 13**), again a four letter identifier for the alternate airport following the same guidelines above for block number 5. This block is not used for a VFR flight plan.

THE FLIGHT PLAN "STRIP"

Now that we have discussed the various blocks on an actual flight plan, let's discover how we can properly put together a virtual flight plan in the chat window (remember that is how you send a flight plan to FSHost for the controllers to use). When planning a virtual flight IFR pilots should remember to file IFR flights even in VMC (visual meteorological conditions). In other words even when they intend to fly VFR. Why, well in the AIM 5-1-3 *Follow IFR Procedures Even When Operating VFR,* it is recommended that to maintain IFR proficiency pilots practice IFR procedures whenever possible *even when operating VFR*. Practice makes it closer to perfect.

The flight plan "strip" that I will show and explain here is a recommended standard for inputting the information via the chat window using the **+fp** command for FSHost. The information here is based on the standard FAA form discussed and kept in the same order as the information on the FAA from including one additional piece of information.

Look at the following typical flight plan "strip" as might be entered by a pilot. Even though this strip depicts an IFR flight, VFR flight plans are very similar but will not need to show an alternate airport.

The above flight plan example would read as follows:

TYPE FLIGHT - This flight plan will be conducted under instrument flight rules (IFR).

ACFT ID - The aircraft identification typically painted on the side of the aircraft (I borrowed this example from a real-life corporate jet that use to be based at my hometown airport).

ACFT TYPE/EQUIP - The aircraft type (and special equipment if applicable), in this case a Cessna Citation with no special equipment indicated.

DEPARTURE ARPT - This departure will be from Charlotte/Douglas International (KCLT). Always use the four letter ICAO identifier and do not drop the first letter because it normally indicates the country of origin, in this case (K) is typical of US based airports.

REQ CRUISING ALT - The requested cruise altitude, in this case 19,000 feet. Any altitude at or above 18,000 feet (again 18,000 feet inclusive) should be preceded with the letters FL (for flight level) and only show the first three numbers of the altitude, in this case 190. So the correct format is FL190. Any altitude below 18,000 feet (18,000 feet not inclusive) is written as is, leaving off the commas. So 12,500 would be input as 12500. This keeps it simple with good readability in both cases. Flight levels are explained in more detail later in the manual.

ROUTE OF FLIGHT - The route of flight should always start for virtual purposes with the *requested* runway of departure (always precede the runway number with the letters RWY and also always put a number zero as a prefix to a single digit runway number such as 08L). Be sure to select a runway that jives with the current wind direction when filing your flight plan unless you particularly like taking off with a tail wind <grin>. Then enter the first fix that is on the planned airway to be used, in this case it is a NAVAID, SPA VOR. This fix connects the flight to the high altitude jet airway J37. Now here is the cool thing about jet airways, once you indicate you are on an airway you don't need to put all the fixes along the airway on J37 into the flight plan. Think about that, a jet airway hundreds of miles long will contain way more fixes than what you will want to list. As long as you stay on that airway ATC will know the route (they can display Low and High Airways within FS Navigator). Some pilots just like filling up a flight plan with waypoints <grin>, but all that work isn't necessary. All that is required next is to indicate any fix where another airway is to be intercepted, major turns en route, or the fix where you plan to jump off the airway to make your approach into the destination airport. In this case there is only one airway and the jumping off point is the fix AJFEB just outside the Atlanta Hartsfield International airport. From there list the runway you would like to land on. Again for virtual flight purposes put the requested runways into the flight plan. It doesn't mean that will be the runway you get either during takeoff or landing, but just like requesting the en route altitude ATC has the option to change this so be prepared (they may not want you to take off with a tail wind <grin>). Later you'll learn the reason for adding the requested runways to the flight plan.

DESTINATION ARPT - This destination airport is Atlanta Hartsfield International (KATL). Always use the four letter ICAO identifier.

ALTERNATE ARPT - Finally if you have filed an IFR flight plan then don't forget to include an alternate airport, in this case Nashville International (KBNA). If you were instead filing a VFR flight plan then the alternate does not apply. I'll discuss VFR flights and flight plans in chapter 4. There is also a detailed discussion on alternate airports in a later chapter.

HOW TO ENTER THE FLIGHT PLAN

When you file a flight plan via the chat window in flight simulator it is sent to the FSHost server so controllers will have access to it as seen in figure 104 below but first let's learn a proper method to enter these.

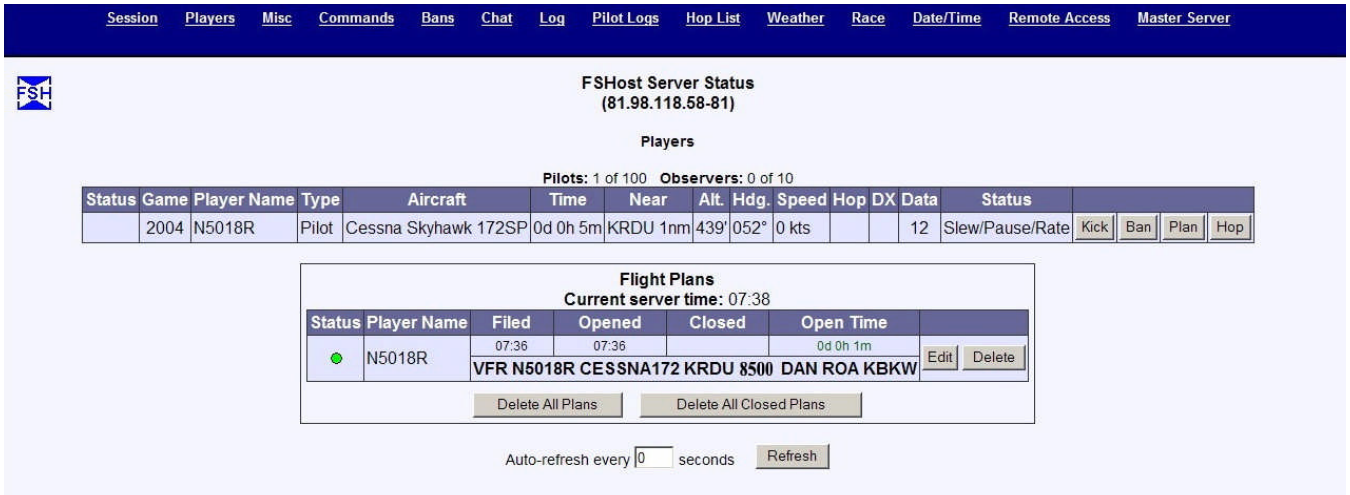


Figure 104 - A typical VFR flight plan shown in FSHost (less the requested runways).

To start a flight plan entry you press the ENTER key while in the flight simulator cockpit and connected to FSHost to make the chat window appear. This method was developed by the author of FSHost to allow each connected player to send a flight plan to the host since Microsoft failed to include a way to transmit the flight plans entered using the flight planner during multiplayer activities. The chat window is seen in figure 105 below. It will show information about each connected player. Here in this case, N5018R a Cessna 172 used in our example.

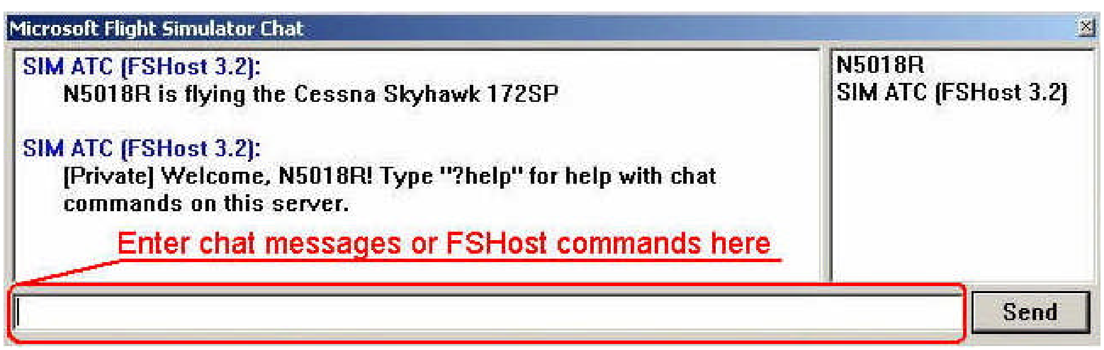


Figure 105 - FS9 chat window.

Once you have the window open you can resize it as any typical window as seen in figure 106 to aid readability. To get a list of commands type **?help** into the entry window (next to where the SEND button is as seen in figure 105 above) and click send (or simply press your ENTER key). This will display the list you see in figure 106. If you notice there is help about flight plans available by typing **?fp**. Type that in and press ENTER.

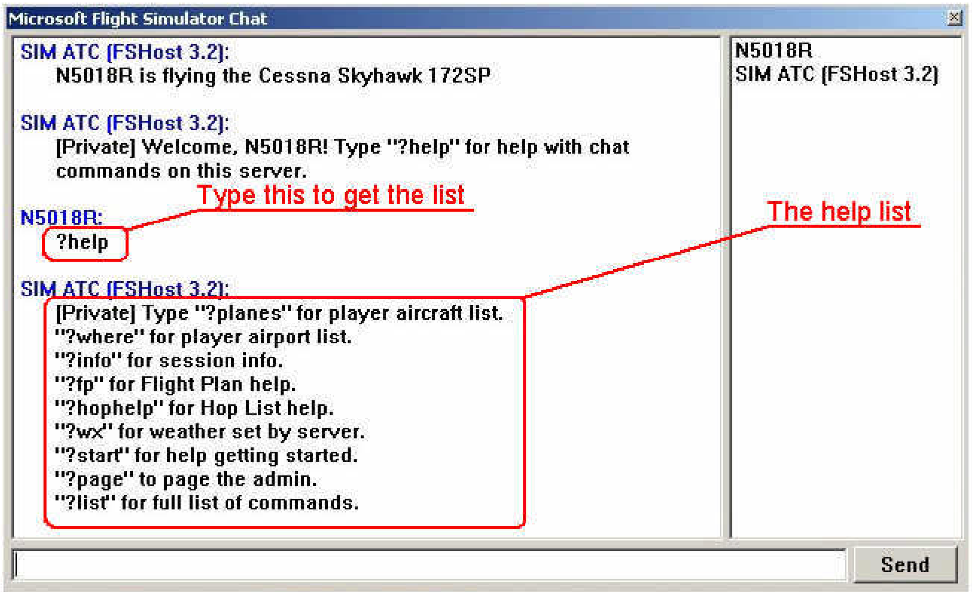


Figure 106 - The help list after entering ?help in the chat window.

That will display information about entering a flight plan but stop there, because we are not going to use this information because the author of FSHost does not do anything to format, or check the accuracy or completeness of the information. So we need to establish a standard in which to input flight plans structured more on the real flight plan form that will enable controllers to more easily read the information when looked at in FSHost. ***PLEASE*** use the method described here in lieu of any specific guidelines provided by the ATC service used as it will make a difference to the controllers who must decipher the information input by each pilot. If each pilot enters the information their own way then that is how many different ways a controller would have to read it. So using one simple standard method will make it easier on the controllers to learn and quickly decipher during multiplayer activities.

Let's enter the flight plan example used above into the entry window next to the SEND button as shown below in figure 107. Be sure to double check the information or you will have to do it all over again to correct it.

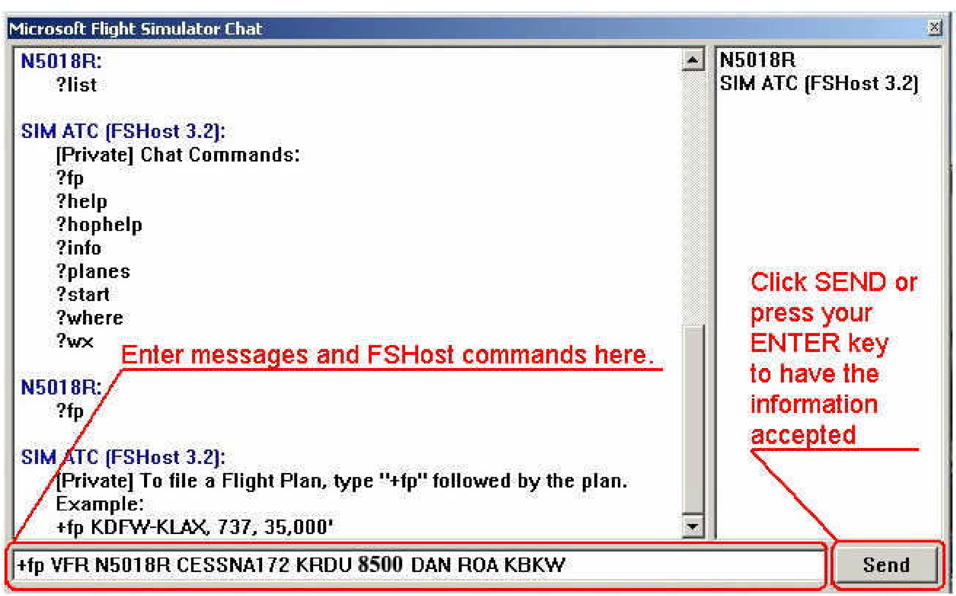


Figure 107 - Entering a flight plan via the chat window.

Notice the **+fp** command used at the beginning of the line. This will tell FSHost that all the data that follows the **+fp** command is a flight plan and FSHost will take it literally "as is" to display within FSHost's public status page and within the administrators page that shows all the players flight plans as depicted in the next two figures 108 and 109.

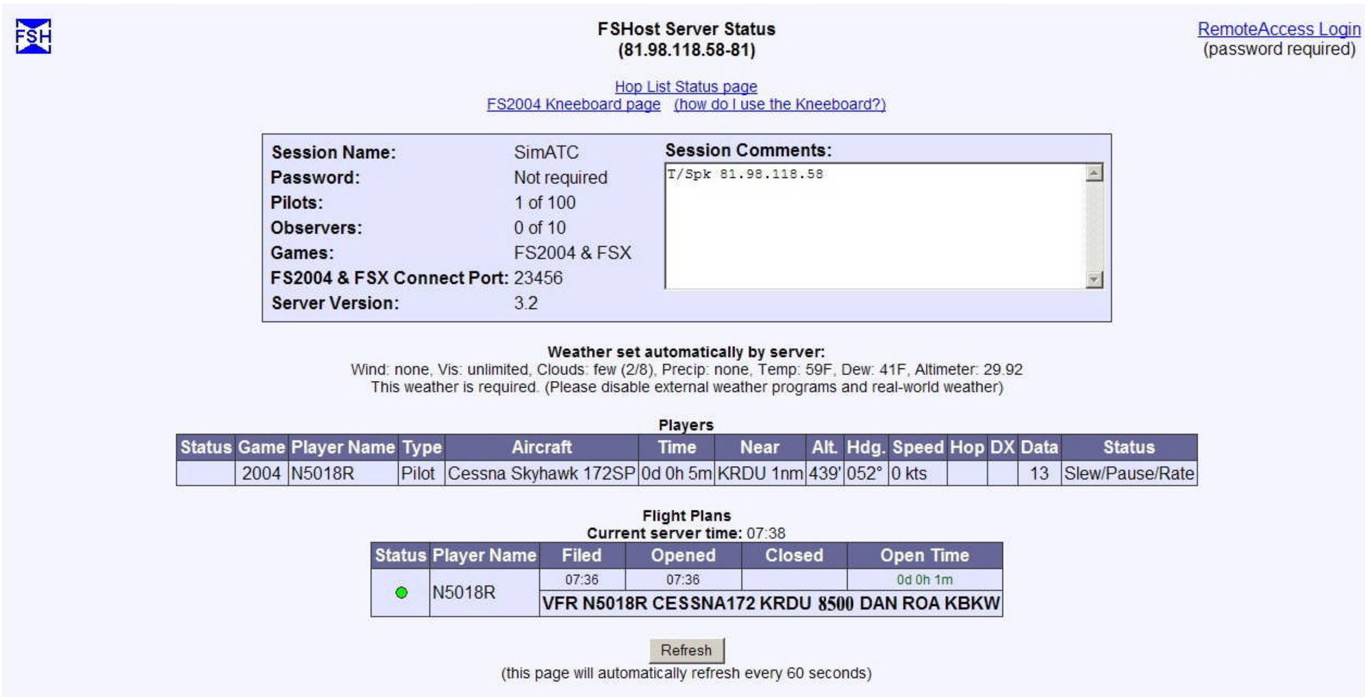


Figure 108 - FSHost public status page.

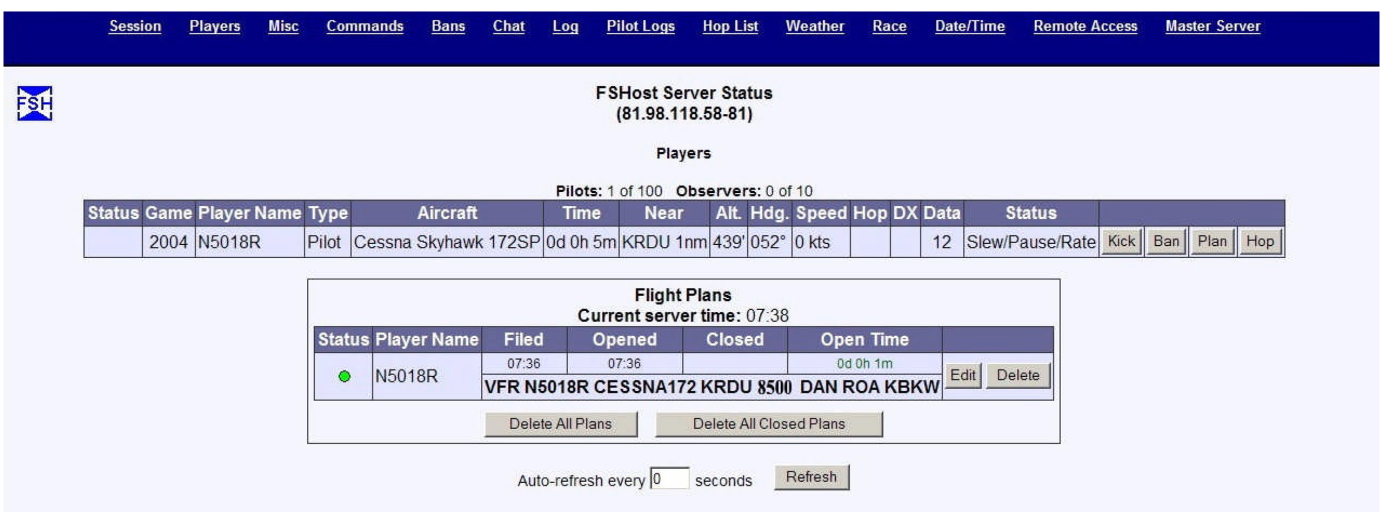


Figure 109 - FSHost administrator's flight plan page.

Again formatted properly and entered in the specific order as taught within this manual will allow you to provide a standardized method of entry in lieu of any other specific guidance provided by the ATC service you may use.

THE VFR FLIGHT PLAN

In real-life VFR pilots file flight plans as an "insurance policy". As an example if you depart from an airport at 1200hr on a 4 hour flight with an estimated arrival time at your destination at 1600hr but don't show up then a search is initiated. Typically the search will first consist of making telephone calls to the destination airport to locate the aircraft (because pilots tend to forget to cancel VFR flight plans) and if found they will cancel the flight plan when it is confirmed you are safe. If the aircraft isn't found then the Calvary is called out to go looking for you as an overdue aircraft possibly down. That is your insurance policy; someone will come looking for you. VFR flight plans are optional for VFR pilots but highly encouraged.

In the virtual world a VFR flight plan is of very little use as is in real-life but it will allow multiplayer controllers to understand your flight intentions, because when you file the flight plan they can see it in FSHost. It is also a good means to practice filing correct flight plans so you will be a more proficient IFR pilot. Learn to file correct and complete flight plans that help the controllers understand your intentions.

THE IFR FLIGHT PLAN

IFR flight is required based on the weather being below minimums for VFR flight. I'll discuss these weather minimums more in the chapters about multiplayer VFR and IFR flight. For now understand that a realistic VFR minimum to use during virtual play is 3 statue miles visibility. So if the visibility set within FSHost's weather is below 3 statue miles visibility then VFR flight is prohibited and IFR rules should prevail. So, per FAR 91.173 *ATC Clearance and Flight Plan Required* it is stated that no person may operate an aircraft in controlled airspace ***under IFR rules*** unless that person has filed an IFR flight plan and received an appropriate ATC clearance. The pilot must file an IFR flight plan to conduct an IFR flight; it is not optional as is the VFR flight plan.

FLIGHT PREPARATION

Multiplayer activities will be much more rewarding if the virtual pilot takes just a few extra minutes to properly prepare for a flight. Here I'll explain how to use the flight simulator flight planning tool and how doing so can benefit your flight. After using the flight planning tool in flight simulator you'll be able to submit a better flight plan route to ATC via FSHost that will go a long way in making the total flight experience better for you and the controllers. You'll also learn where to get specific information useful during a flight such as the weather conditions.

MULTIPLAYER SESSIONS UNDER ATC CONTROL

All pilots most realize that if connecting to an online ATC service that it is always advisable to also connect to their communications server (TeamSpeak in our case) so as to properly determine if an active ATC session is underway. Look for controllers in the channels as seen in figure 110 below.

Figure 110 - Active controllers in TeamSpeak.

If controllers are present then it should be automatically understood that the rules for minding controlled airspace are in effect and should be respected. The active controllers will know you are there and will start keeping an eye on you depending on the activity. You can fly a complete VFR flight without ever speaking to a controller as long as you follow the rules for VFR flight (visibility at 3 miles or above, stay clear of clouds, and don't penetrate controlled airspace without permission). If at any time you plan on entering controlled airspace as defined (anywhere on the virtual planet) then you must contact the controller labeled ATC1 on the communications server and make your intentions known else you may be "kicked" from the server to prevent interference.

Typically if a pilot enters controlled airspace during an active session without first contacting the ATC1 controller and is not available on the communications server to speak with, the lead controller will try to make contact with the pilot via text messaging through the multiplayer server (FSHost). This is normally a request to come up on the communications server so as to make verbal contact (as text messaging is cumbersome). If that is not possible then the pilot will normally be cautioned not to improperly interfere with any ongoing activity. As long as the pilot doesn't interfere then they will most likely be allowed to stay connected otherwise if the pilot penetrates airspace where other pilots are flying under proper ATC control the lead controller may "kick" the player off the multiplayer server to prevent interference. If the pilot returns again not minding the warning from being kicked the first time then normally the pilot will be banned for the duration of the activity (sort of like taking their pilots license from them <grin>). If no controllers are present on the multiplayer server then it is free for use by anyone without any ATC restrictions. So be aware if a scheduled session with active controllers is underway!

HOW TO DETERMINE WIND DIRECTION AND SPEED

If departing an uncontrolled (non-towered airport) how does the virtual pilot choose the proper runway before taxi? In other words how does the pilot determine the wind direction and speed so they can select an appropriate runway to take off into the wind? Well let's discuss how the real pilot does it. In real-life the pilot may have several options, they might listen to a local automated ATIS broadcast, they may look at the airport wind sock (*you know that striped looking sock that Dr. Seuss left hanging on a pole <grin>*).

Figure 111 - Airport wind sock.

It may be provided by an FBO (Fixed Base Operator) who may have a wind and barometric gauge to allow them to provide the current readings. An FBO is the folks that work at the uncontrolled airport providing fuel, parking and other basic services for pilots. They may also relay communications heard from other aircraft either departing or arriving at the airport.

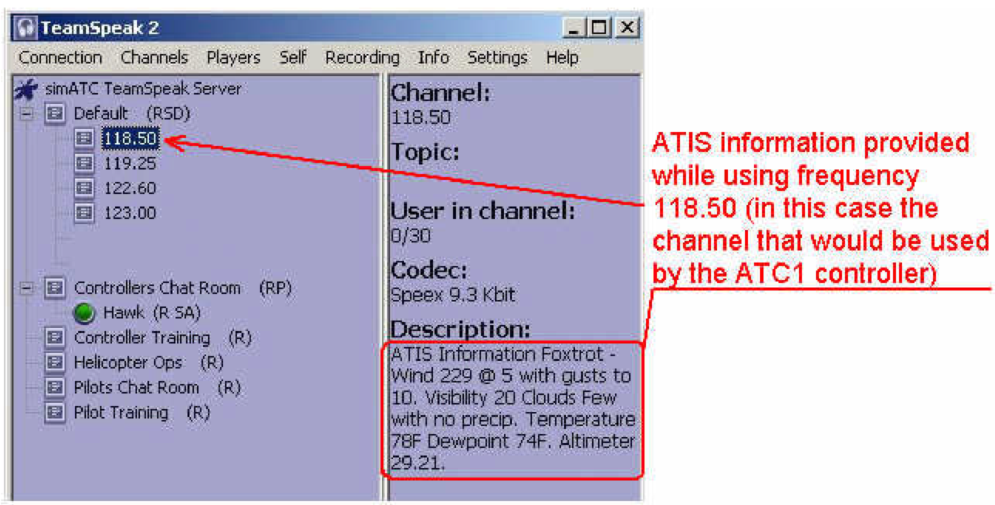


Figure 112 - ATIS information posted on the first TeamSpeak channel (here that is 118.50).

The virtual pilot can find the current ATIS information during an active ATC session typically posted on the first channel on TeamSpeak as seen above in figure 112 (Caution: this is manually entered by the controllers and may not be up-to-date). If you wish to be absolutely sure of the current available weather then check the public status page for the FSHost server you are connected to similar to figure 113 shown below. This will always show the current weather provided by the server.

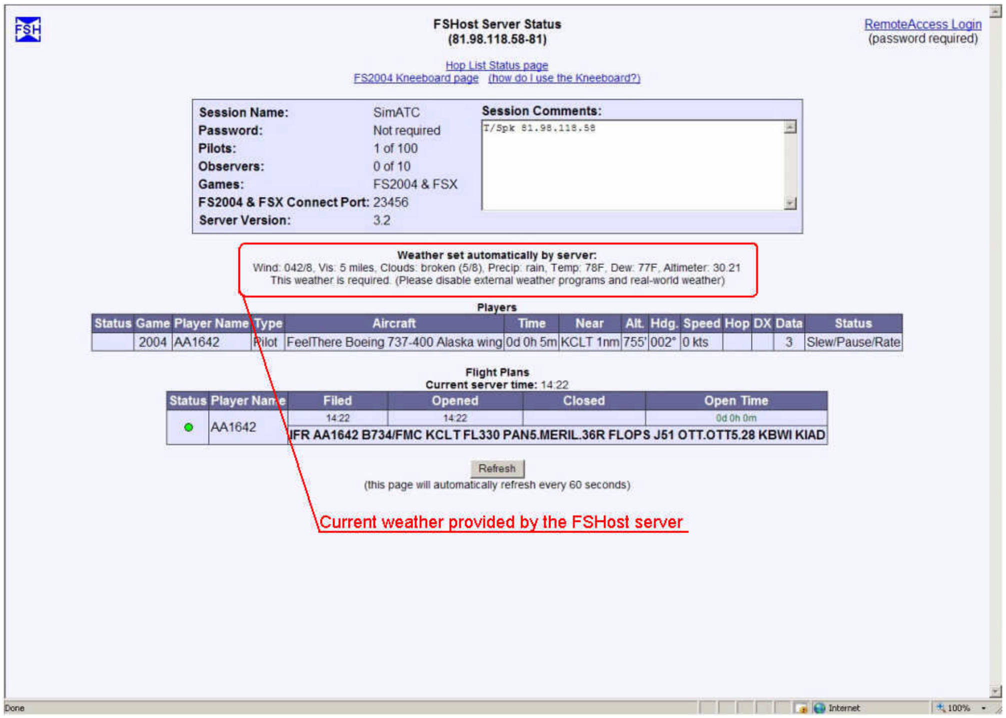


Figure 113 - Current weather shown on the public FSHost status page.

HOW TO PROPERLY SET THE ALTIMETER

The barometric setting is also part of the weather information shown on the FSHost public status page, but WHAT IF a barometric reading were not available? W*hat if the current altimeter setting were not posted in TeamSpeak or available via the public status page for the server, how would the pilot handle this? How does the pilot ensure the altimeter is set correctly before taking off on their flight?*

At uncontrolled airports in lieu of an available calibrated barometric setting the pilot must turn the altimeter dial to make it properly read the airport altitude as published in appropriate maps or airport charts before takeoff, instead of dialing in a barometric reading into the Kollsman window as would normally be the case. In figure 114 below airport altitudes are circled in red on a partial view of a VFR sectional map used by VFR pilots for navigation.

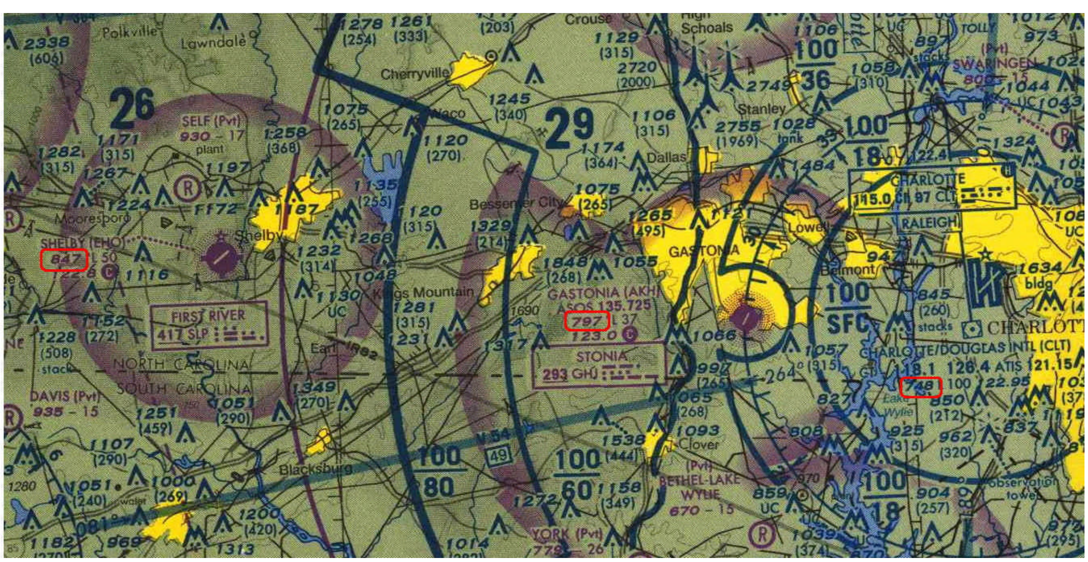


Figure 114 - Partial view of a VFR sectional with airport altitudes circled in red.

These are the altitudes a pilot might use to set an altimeter to the airport altitude before takeoff when a calibrated barometric pressure setting is not available.

You can get the airport altitude within FS9 by bringing up the map view as we did earlier for determining if an airport had a control tower frequency listed, this time instead for the airport altitude. If you compare the altitudes seen in figure 114 above and below in figure 115 you'll see the airport altitudes match.

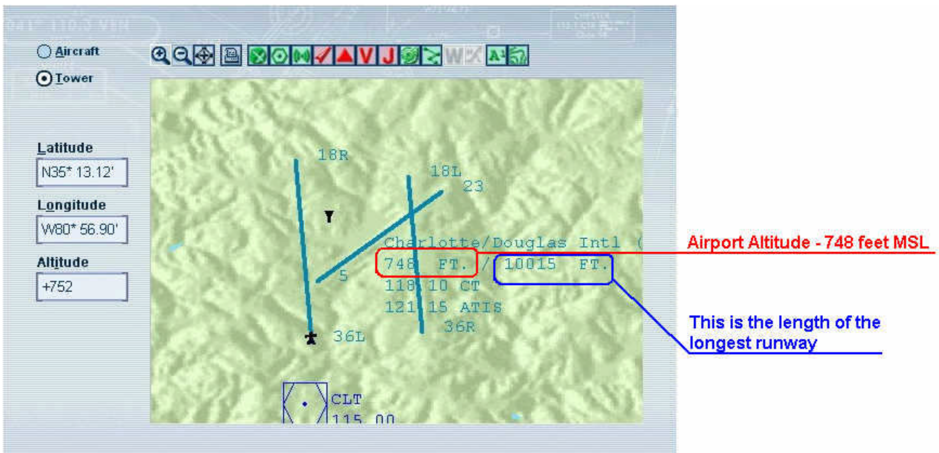


Figure 115 - FS9 map view of KCLT (airport altitude is 748 feet MSL).

Once the airport altitude is set, the Kollsman window will show you the local barometric pressure as long as the altimeter is working correctly (and we know all simulator aircraft are certified and ready to fly right <grin>). Again, this is the opposite of typical operation where the pilot is normally given a known calibrated pressure reading to set into the Kollsman window to allow the pilot to read the actual altitude.

As a matter-of-fact if a controller were to provide a real-life pilot a calibrated barometric reading while parked on the airport ramp and you set that reading into the Kollsman window, the altimeter altitude should not be greater than plus or minus 75 feet of the published airport altitude (reference the AIM 7-2-3). If the altitude shown falls outside these parameters the altimeter accuracy should be considered questionable and should be evaluated by an appropriate repair station before flight. Again, hopefully all virtual altimeters are working properly <grin>!

AIRWAYS

En route airways have been established for many years now built around the variable omni-range (VOR) transmitter infrastructure. There are two layers of airways provided, low en route airways (referred to as Victor Airways) for navigation of flights conducted below 18,000 feet MSL and high en route airways (referred to as Jet Airways) for navigation of flights conducted at or above 18,000 feet MSL.

VFR pilots typically use VFR sectional charts that depict the low en route airways overlaid on maps that provide topographical representations of the terrain along with visual features such as railroads, lakes, highways, mountains, power lines, and much more that help the VFR pilot navigate by visual references.

IFR pilots typically use IFR low and high en route charts designed differently than the VFR sectional charts depicting things important to flight in IFR conditions. They lack the topographical and visual references provided in VFR sectional charts but provide other information such as many forms of altitudes so IFR pilots can safely clear terrain and obstacles even if not visible in instrument meteorological conditions (IMC) such as a minimum en route altitude (MEA). The IFR pilot is provided more information that relates to radio navigation (instead of the visual aids) to conduct lateral navigation of the terrain.

The IFR high en route charts provide another set of airways for aircraft that fly more economically at higher altitudes (there engines tend to be more happy at these altitudes <grin>). Similar information is provided on these as is provided on the IFR low en route charts.

The information on these charts and maps are constantly being updated and distributed so pilots can fly safely along predetermined routes with known safe altitudes. So it benefits any pilot to use these established airways whenever possible due to the abundance of available information.

These airways are easily displayed on FS Navigator for use by controllers during online activities so when pilots use the airways it is easier for controllers to understand their flight route. The information on the charts and maps can also be used by controllers to ensure pilots are provided safe altitudes during departures and arrivals into airports (the most critical segments of flight, even in a virtual activity).

If you lack the knowledge to read these charts and maps then spend some time here, it will go a long way to improve pilot or controller skills.

VOR TECHNOLOGY

Variable Omni-Range transmitters are a land based system. This means a special transmitter is built at a specific location to emit a signal 24/7 that a pilot can receive via a VOR receiver available in the aircraft. The frequency range is between 108.00 to 117.95MHz. These transmitters are scattered all over the world enough so to allow them to form a network of airways world-wide. The aircraft receiver picks up the signal from a VOR transmitter that the pilot has tuned (selected a frequency) and translates that signal into usable visual information via the VOR gauge mounted on the cockpit panel. The pilot uses the gauge to properly track a selected VOR “radial” (radials are the specific compass points from 000 to 359 degrees in one degree increments aligned with magnetic north) and provide a means for pilots to recognize when deviating from the selected radial (a specific line to or from the VOR transmitter).

Figure 116 - Land based VOR transmitter.

AIRWAY CHARTS AND ROUTES

If you're a VFR pilot then the airway charts and routes you will use are found on VFR sectional charts reference figure 117). As mentioned these charts provide an abundance of visual references for pilots to navigate by. Using specific scenery enhancements for flight simulator the virtual pilot can easily navigate using real-world charts by finding roads, railroads, lakes, rivers, power lines and more. These charts use the low en route airways (reference figure 118).

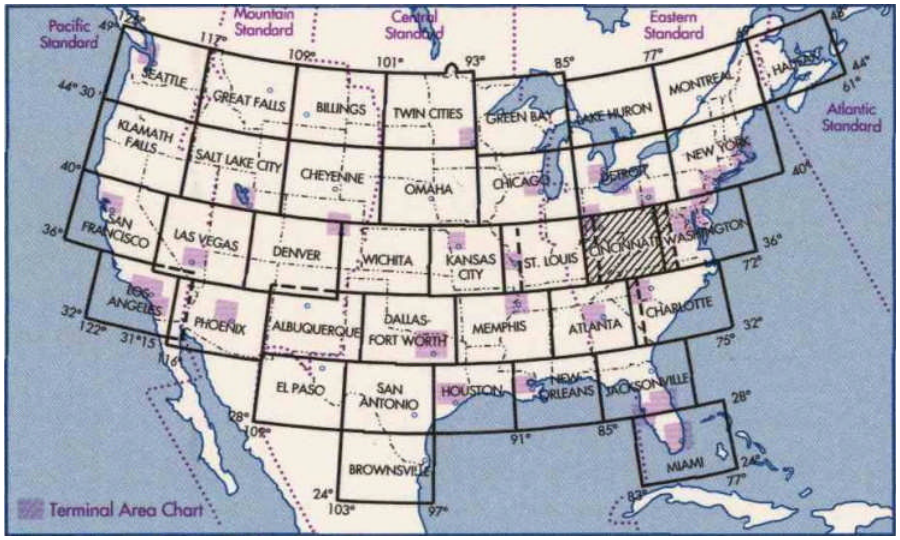


Figure 117 - VFR sectional charts covering the U.S.

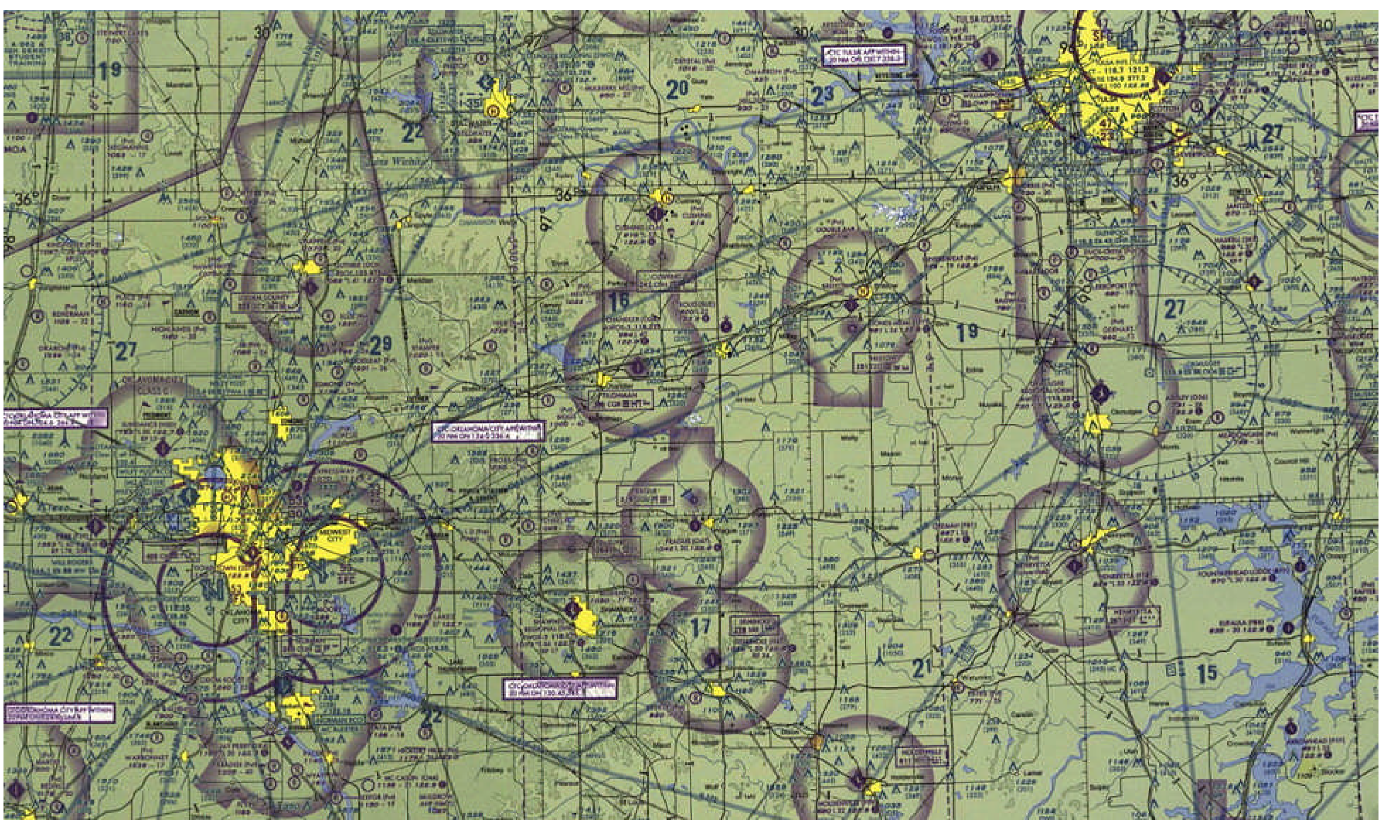


Figure 118 - Partial section of the Dallas/Fort-Worth VFR sectional chart.

Terminal area charts are also available for VFR pilots providing a better view of specific areas that contain high density airports such as the Dallas/Fort-Worth TCA seen here in figure 119.

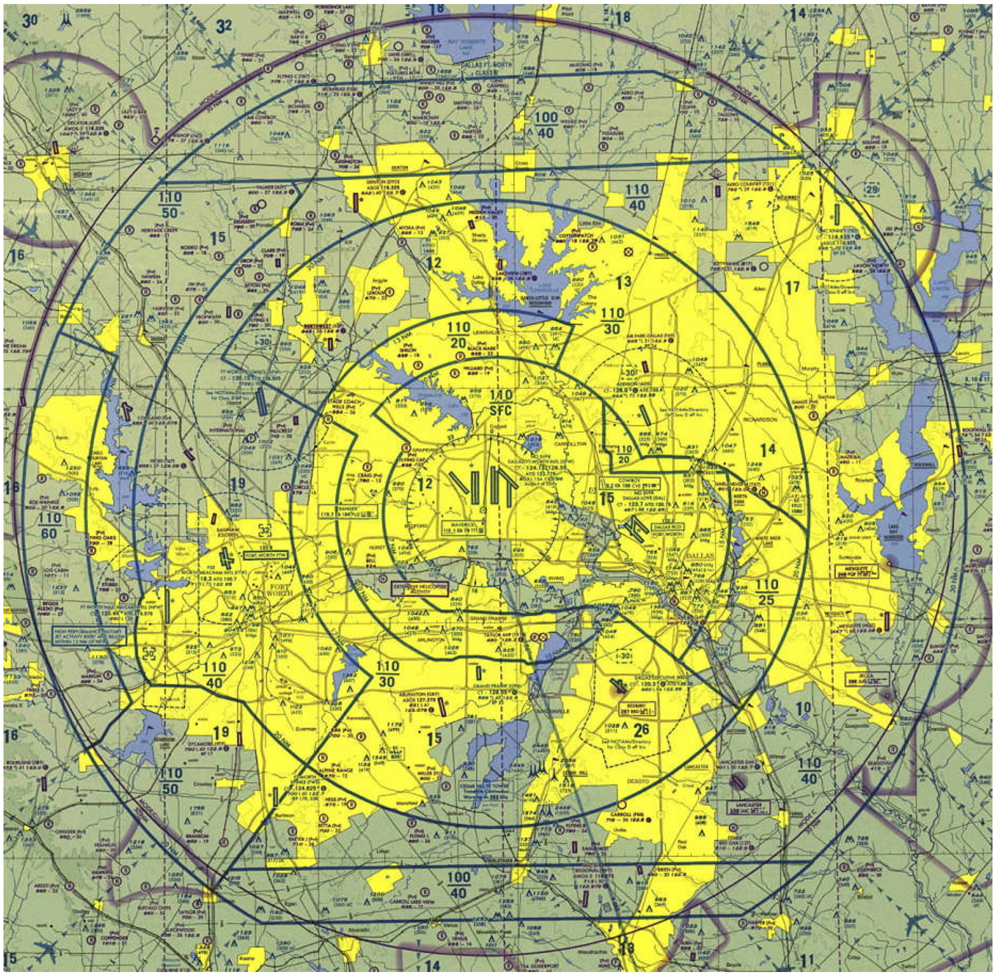


Figure 119 - Partial Terminal Area chart (TAC) of the Dallas/Fort-Worth TCA.

Low en route IFR charts provide airways better suited for aircraft flying IFR at altitudes up to but not including 18,000 feet (such as smaller aircraft that can not reach the high en route airways).

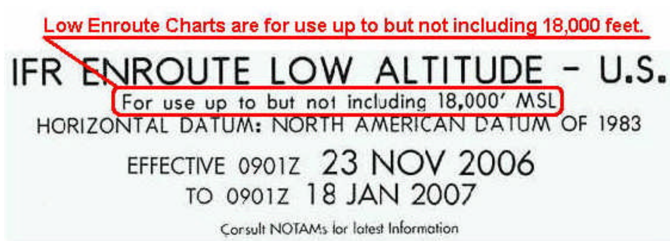


Figure 120 - IFR En Route Low Altitude chart header.

Low en route IFR charts provide information more suited for pilots flying strictly by radio navigation without the aid of any outside visual references. This information contains radio frequencies, various types of altitudes, ARTCC/FIR boundaries, and much more. Figure 121 shows the low en route charts that cover the United States. Area charts (not shown here) are also available that cover more specific high density areas just like the VFR terminal area charts cover high density areas.

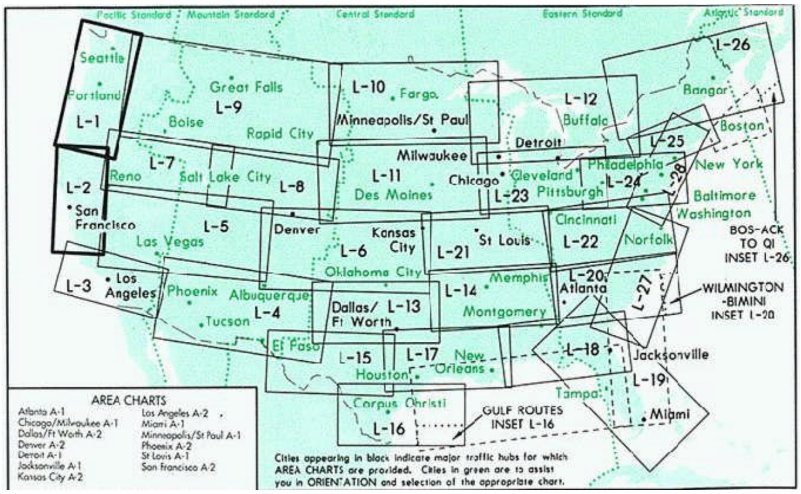


Figure 121 – U.S. Low En route Charts.

Figure 122 - A partial section of the L-6 Low En route Chart near KDEN.

High en route IFR charts provide airways better suited for IFR aircraft that can reach altitudes at or above 18,000 feet.

Figure 123 - IFR En Route High Altitude chart header.

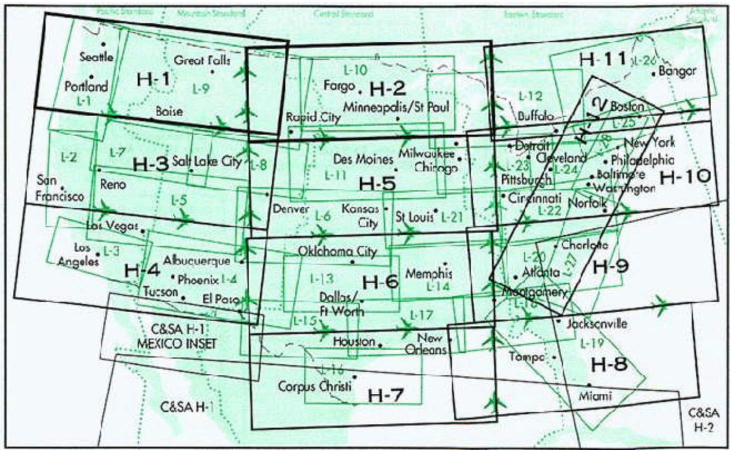


Figure 124 - U.S. High En route Charts.

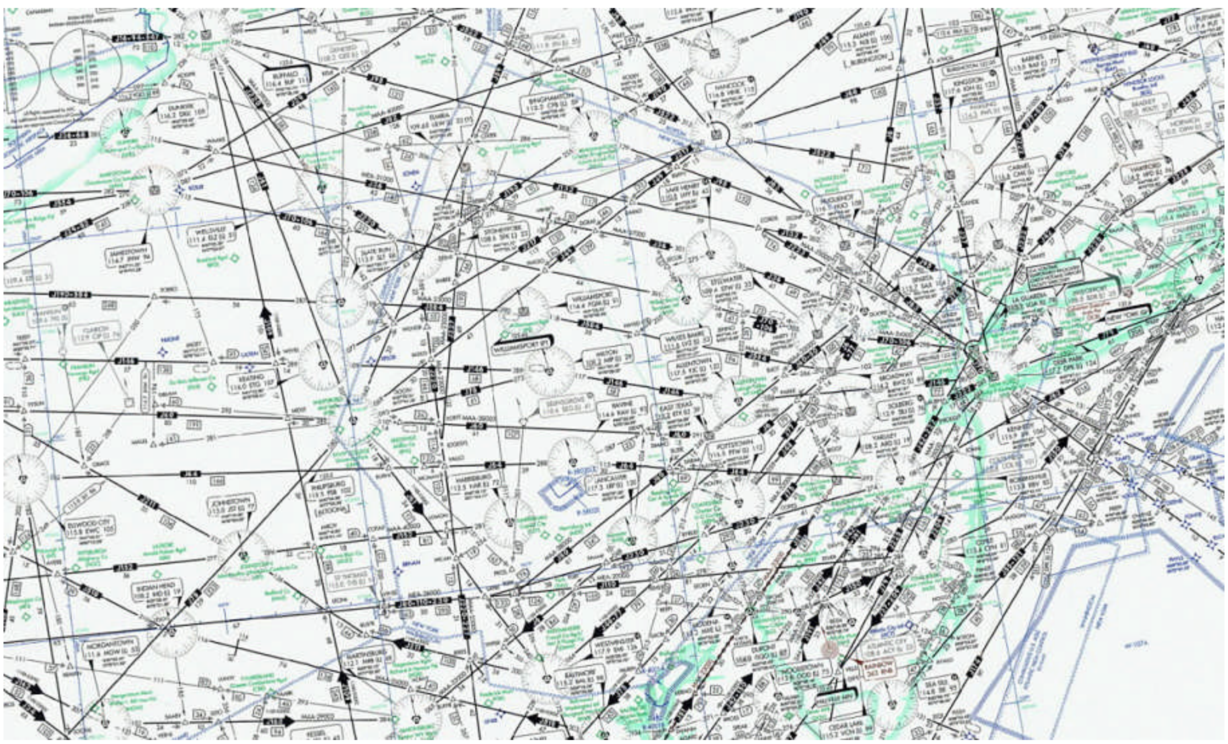


Figure 125 - Partial section of the H-10 IFR High En Route chart.

Why not just have one set of airways, why two? Well mostly for technical reasons. We have already mentioned one important note, aircraft operating altitudes. The differences are due to terrain and line-of-sight concerning radio signals. VOR transmitter signals work in the higher radio bands where the signals are not affected by things like thunderstorm static (as with NDB transmitter signals) but will be affected by such things as ground terrain, hence the line-of-sight problem. The low en route charts provide safe navigational routes for aircraft that can *not* reach the higher routes by ensuring proper signal overlap between stations. This allows aircraft flying at the lower altitudes to properly navigate from one transmitter to the other. The en route charts even provide for "change over points" at times where the pilot is instructed to tune the next transmitter. The higher jet airways don't suffer from the typical line-of-sight issues due to the higher altitudes. You wouldn't want to use high en route charts at low altitudes because you may experience gaps because those routes are not designed for proper signal overlap by way of specific transmitter spacing, power output, and line-of-sight issues compensated for in the lower routes. Hence we have two sets.

AIRWAY ALTITUDES

It must be presumed pilots flying IFR will not be able to see the underlying terrain and obstacles due to IMC conditions during flight so there must be a way to determine safe en route altitudes. Well, the low and high en route maps do just that. If you closely examine any of the en route charts mentioned you'll find they provide minimum safe altitudes (MSA), minimum en route altitudes (MEA), and other important altitudes such as minimum safe crossing altitudes (MCA), or minimum obstacle clearance altitudes (MOC) between the en route NAVAIDs, waypoints, and fixes used on the charts. The pilot only needs to choose a flight altitude at or above these minimum altitudes to safely navigate the airways (if flying IFR ATC does it for you).

If you examine the quadrangle (the sector circled with the blue square) in figure 126 below you will notice the "Off Route Obstruction Clearance Altitude (OROCA)" (reference the note found on these charts about the OROCA in figure 127). This would be an altitude of interest to those who might plan a flight using a GPS for direct navigation. This is the altitude an aircraft can safely navigate anywhere within the boundaries of the quadrangle and remain clear of all terrain and obstacles.

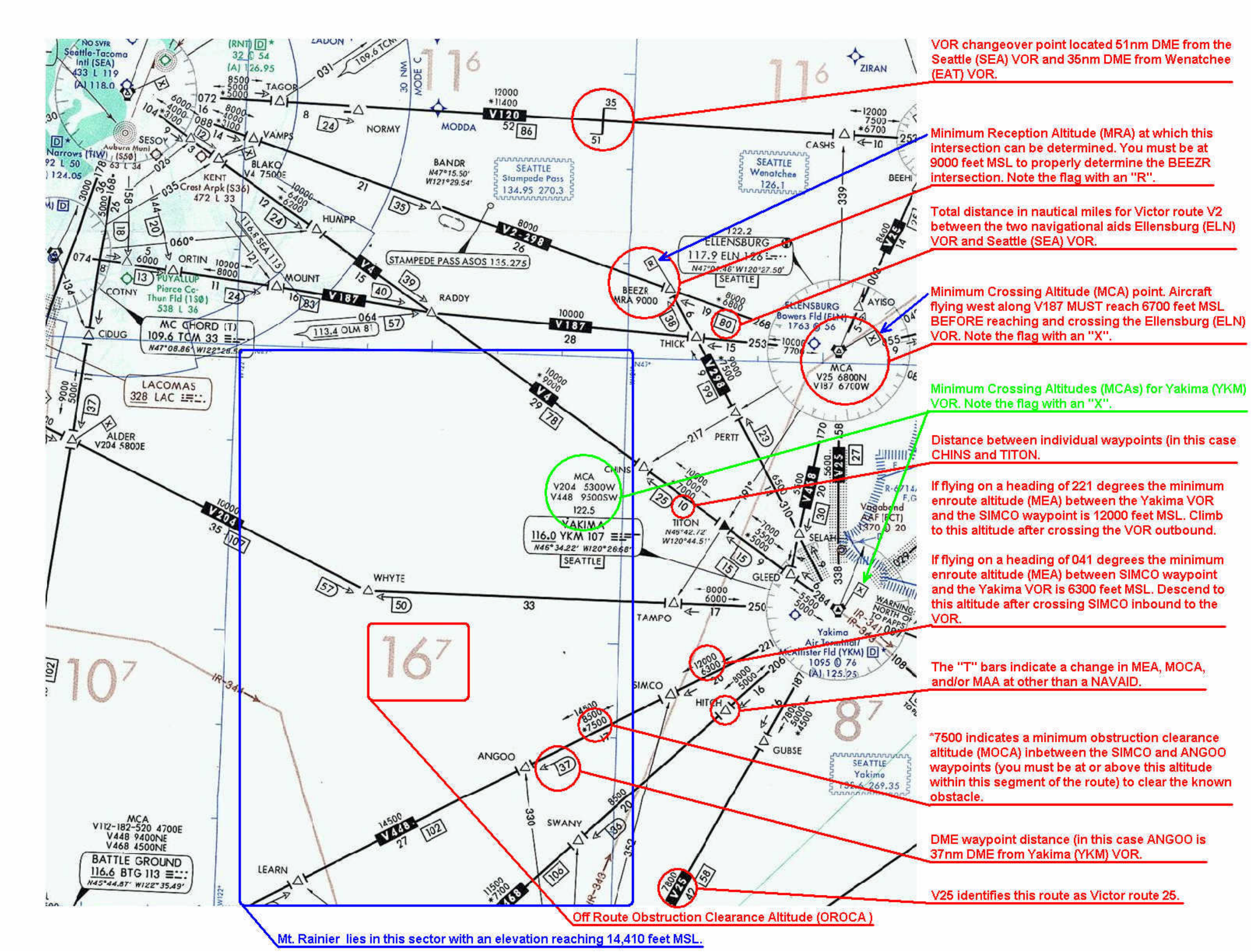
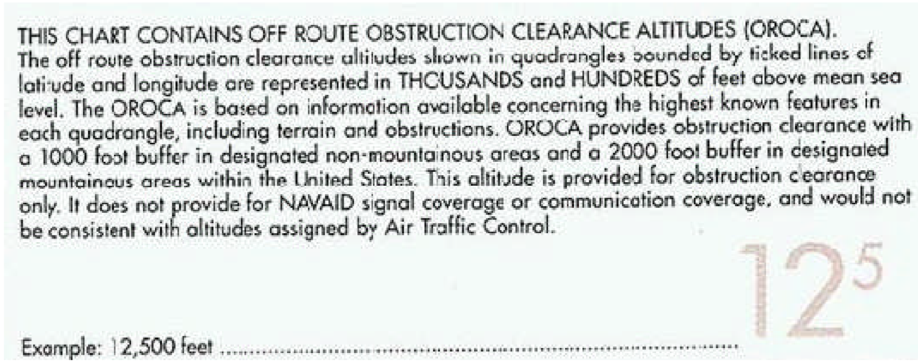


Figure 126 - Partial Low En Route IFR chart with annotations about important information.

In figure 126 I have annotated several of the more important altitudes and symbols used on low en route charts that would benefit the flight simulator pilot greatly. Take a moment to examine those marked.


THIS CHART CONTAINS OFF ROUTE OBSTRUCTION CLEARANCE ALTITUDES (OROCA).
The off route obstruction clearance altitudes shown in quadrangles bounded by ticked lines of latitude and longitude are represented in THOUSANDS and HUNDREDS of feet above mean sea level. The OROCA is based on information available concerning the highest known features in each quadrangle, including terrain and obstructions. OROCA provides obstruction clearance with a 1000 foot buffer in designated non-mountainous areas and a 2000 foot buffer in designated mountainous areas within the United States. This altitude is provided for obstruction clearance only. It does not provide for NAVAID signal coverage or communication coverage, and would not be consistent with altitudes assigned by Air Traffic Control.

Example: 12,500 feet 12⁵

Figure 127 - Low En Route chart note about the OROCA altitudes.

I should note that most experienced real-life IFR pilots will carry VFR sectionals with them even when flying IFR, why? Well, in those bad moments when crap happens and you are going down against your will it is nice to have those VFR sectionals handy after you're below all of the published minimum safe altitudes on an IFR chart. You ask why again, well it's simple, you'll be using the VFR sectional map topology to find some of those canyons and low lying areas that you'll be praying to be over when you break out of the clouds instead of running smack into the side of a granite mountain!

Compare the partial VFR sectional in figure 128 below of the same area shown in figure 126 above.

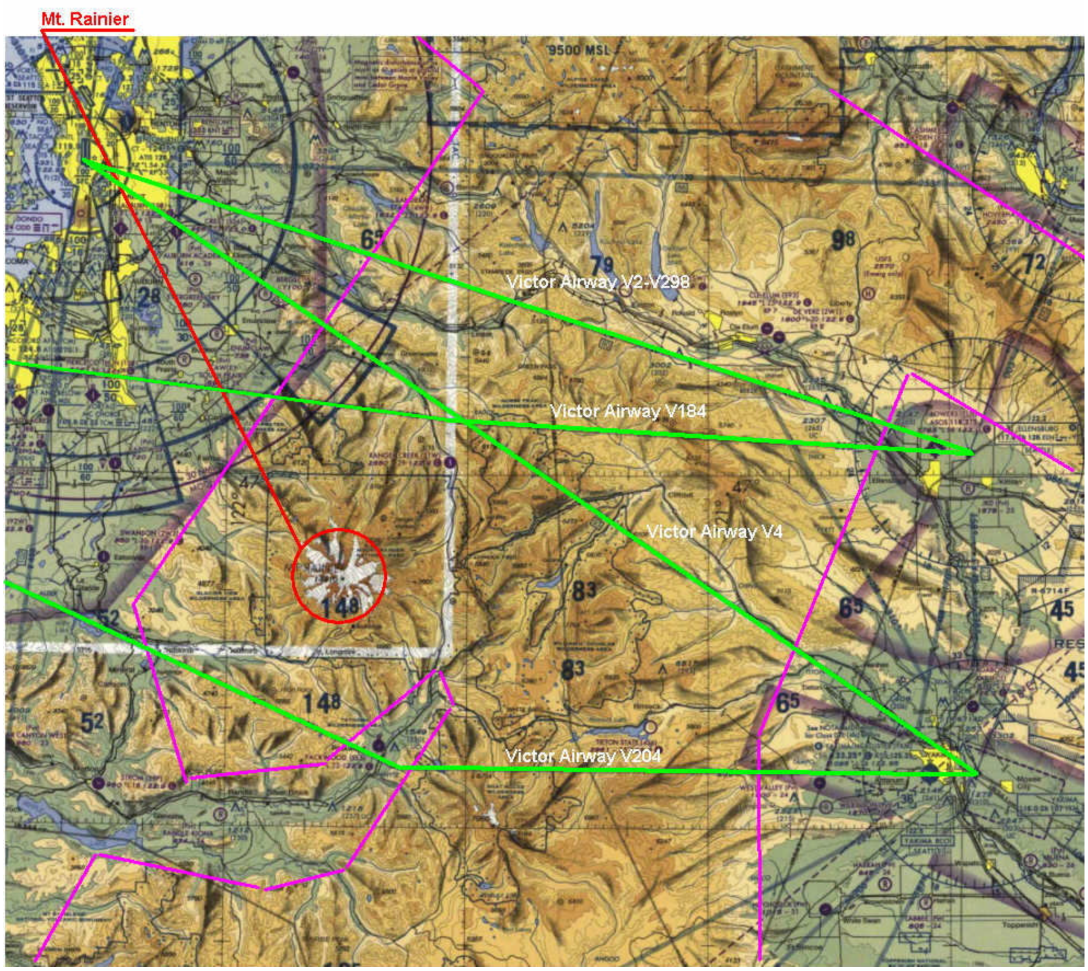


Figure 128 - VFR sectional of the area represented in figure 126.

Example, you're flying from the Yakima (YKM) VOR to the Seattle (SEA) VOR via Victor airway V4 during the winter in a Cessna 172 in IFR conditions and start picking up *unexpected* ice 40nm DME from YKM. Your doing everything correct but soon you realize to keep the aircraft from stalling you need to put the nose down because the combination of ice on the wings, the engine running at lower RPMs due to carburetor heat set at max (and occasionally choking on the ice buildup that breaks loose and goes through the engine), and the high altitudes required over the route are maxing out the aircraft performance because of the added ice on the wings. You were trying to make it to the cloud tops and into the sun but now you have run out of options, going on isn't going to happen and it's to late to turn back, so now you need to think about where you're going to pop out at the bottom if you can even do that, what was that cloud base height again?. Looking at the sectional there are valleys that work their way around the south end of Mt. Rainier to the northeast up to V4. The IFR charts wouldn't give you this option because the topology is not shown on them. Now you have another option to work with by having the VFR sectional handy, not a perfect option but better than nothing.

AIRWAY TRANSITIONS

Transitions are the part of the flight just after takeoff that get us to the airway of choice, and when leaving the airway to get to the initial approach fix (IAF) for landing. There are standardized charts for these called Standard Instrument Departures (SID) and Standard Terminal Arrival Routes (STAR). I'll discuss how to conduct SIDs and STARs in detail within chapter 5 about multiplayer IFR flight but here I want to show you how they relate to getting on and getting off en route airways. Take a look at this KLAX SID named CHATY TWO DEPARTURE in figure 129 below.

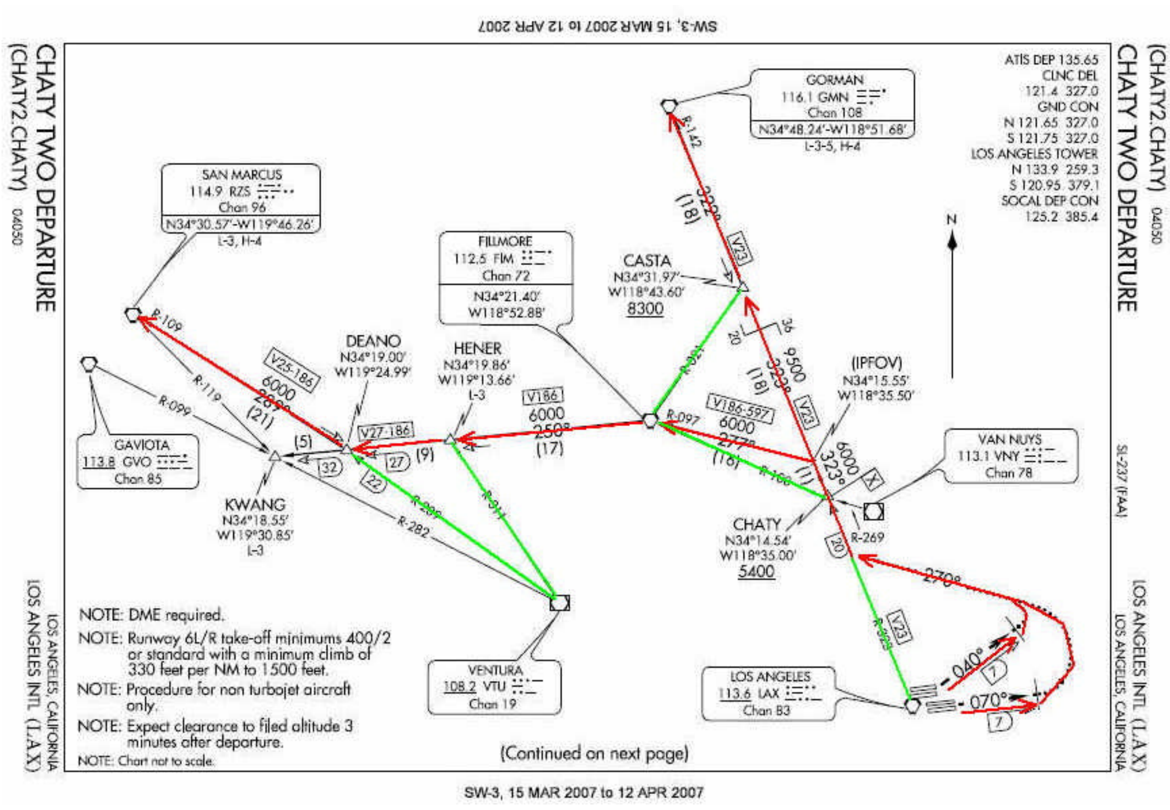


Figure 129 - KLAX CHATY TWO DEPARTURE (SID) CHATY2.CHATY

If taking off from 6L/R or 7L/R ATC would radar vector the pilot similar to the dotted lines shown on the chart with initial headings of 040 and 070 degrees but because the virtual controller may not have the SID handy that the pilot wishes to fly the controller would probably clear the pilot to fly the SID just after takeoff. The pilot would then fly the route by the dotted lines as indicated (this is the actual procedure for using this SID in real-life for a communications failure just after takeoff). The pilot would fly the 270 degree heading until intercepting R-323 outbound from LAX VOR and thence. If headed north the SID hooks the pilot into V23 up to the Gorman VOR, if headed west the SID hooks the pilot into V186-597 at the IPFOV waypoint and then to V27-186 at the Fillmore VOR. This is how SIDs and STARs should be used, to get onto the en route airway filed or to get off the airway headed for the initial approach fix (IAF) to conduct the instrument landing at the destination airport.

Now take a look at figure 130 below (partial view of the low en route IFR chart that covers the SID) which has the SID annotated on it. By comparing the two you can see how the SID simplifies the information required to get off at KLAX and on your way. Once the end of the SID is reached you can use the low en route chart to continue safely on your way without any problems.

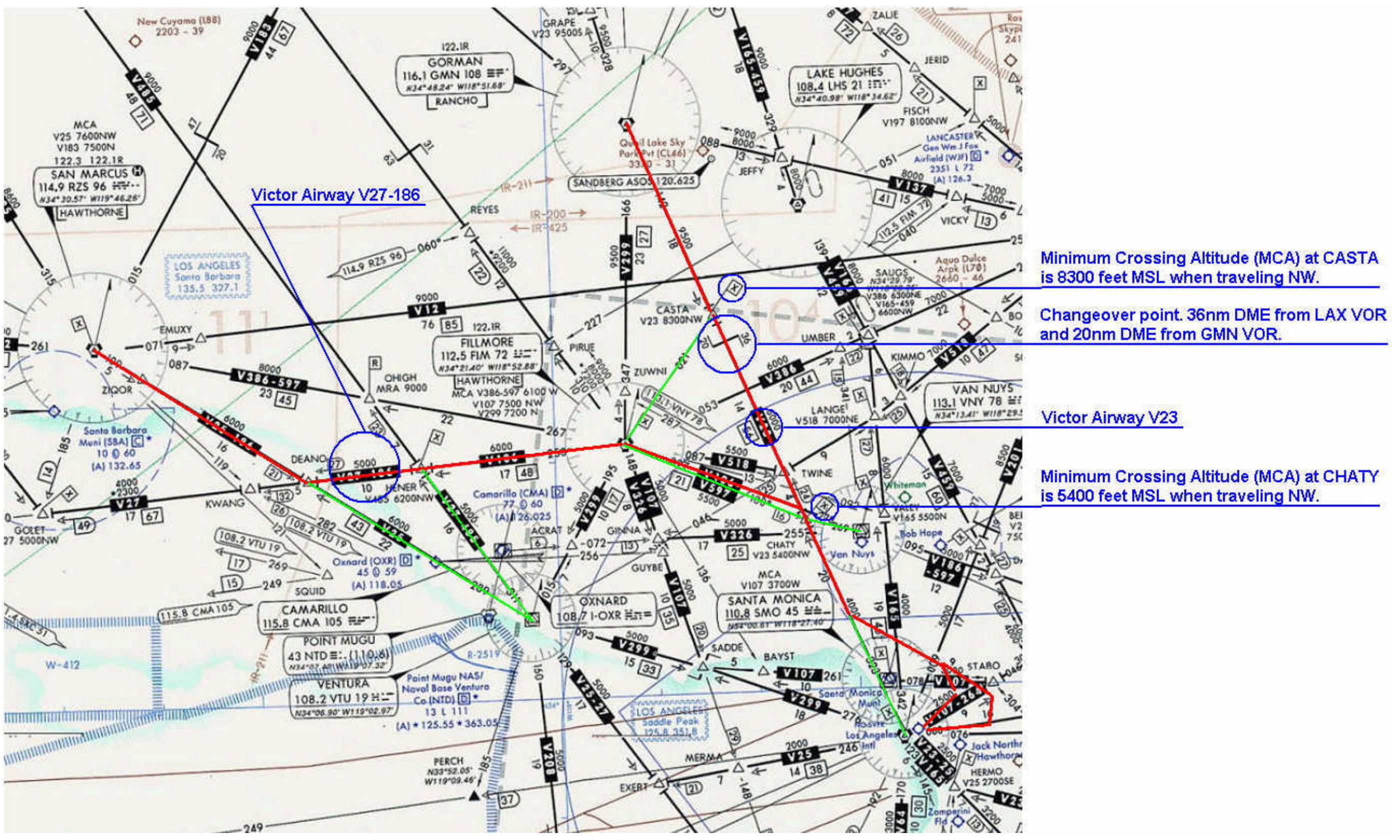


Figure 130 - Low En route chart with the CHATY TWO DEPARTURE annotated in red.

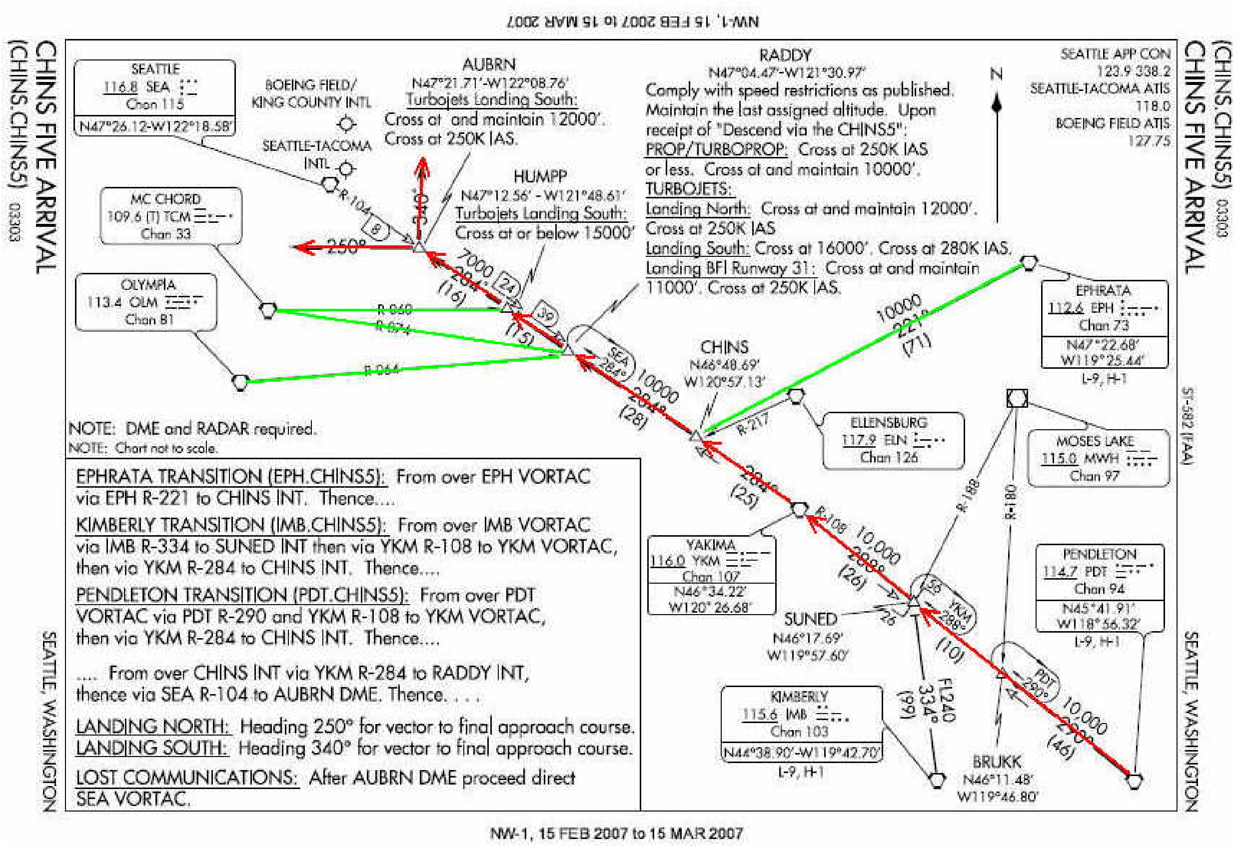


Figure 131 - KSEA CHINS FIVE ARRIVAL (STAR) CHINS.CHINS5

Now take a look at figure 131 above which is the KSEA CHINS FIVE ARRIVAL also annotated on the low en route chart in figure 132 below. The virtual controller could clear the pilot for the CHINS FIVE ARRIVAL when approaching the Yakima VOR. The pilot would only need to follow the indicated routing for the arrival. Upon reaching the AUBRN waypoint the virtual controller would vector the pilot to intercept the final approach course either via a heading 250 degrees for landing north or via a heading of 340 degrees for landing south.

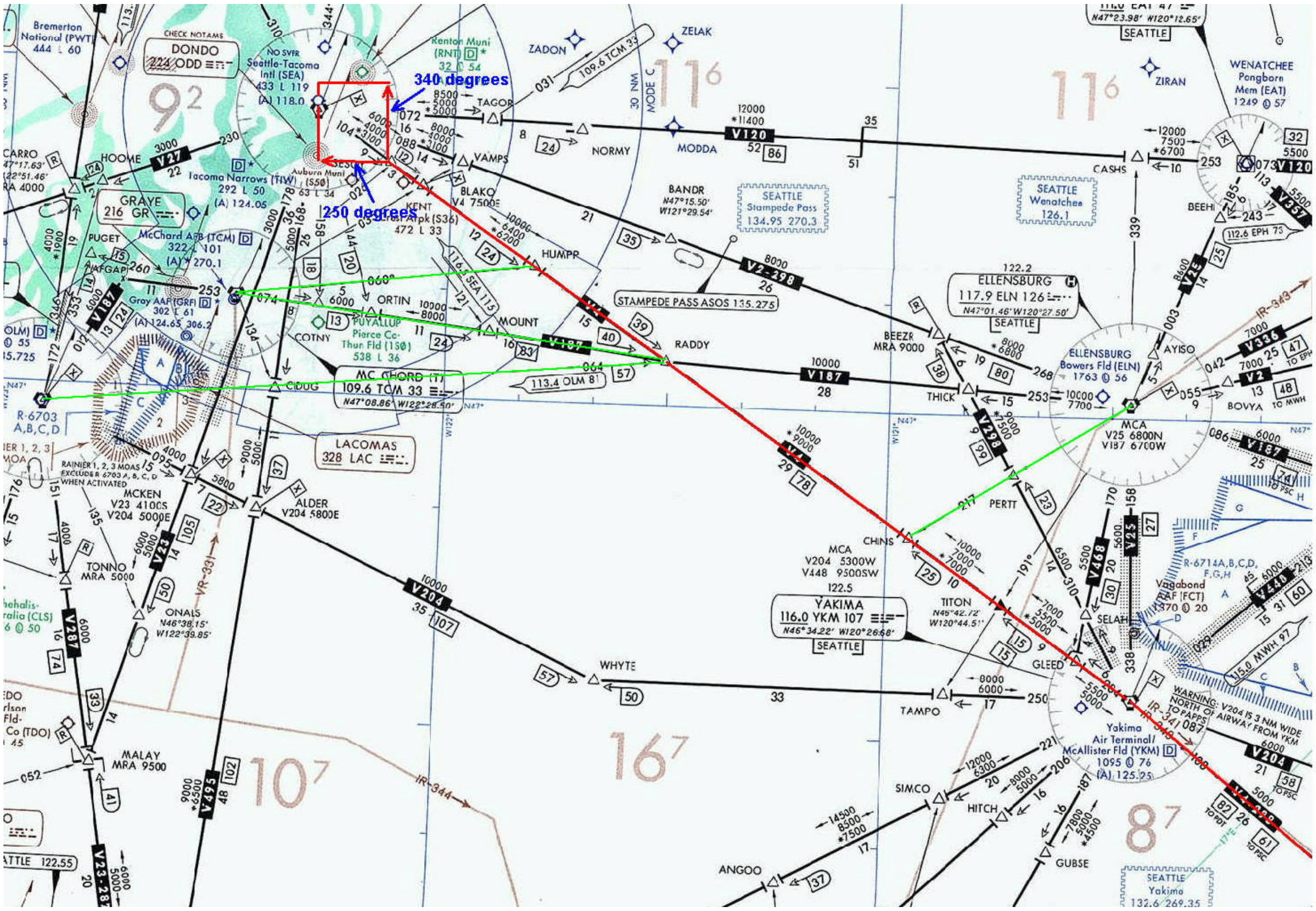


Figure 132 – Low en route chart with the CHINS FIVE ARRIVAL annotated in red.

Not all airports have SID and STAR charts. If SID and STAR charts are available use them as they have the minimum safe altitudes marked on them just as en route maps provide. In cases where SIDs and STARs are not available the pilot must choose the transition routes during flight planning or a controller may vector the pilot for the arrival and approach, not a difficult task but again make sure to mind minimum safe altitudes until either reaching the airway of choice to continue safely on your way or when descending for the arrival and approach.

CONSIDERATIONS FOR FLYING DIRECT

Now direct routes are always the shortest easily conducted via the GPS 500. The pilot normally inputs the departure and destination airport and the GPS does the rest drawing a straight line between the two but there are some pros and cons to consider. First, direct routes normally mean you're not going to be on a published airway. So the pilot has complicated his job because he must now carefully plan his safe cruise altitude without the aid of published routes just as previously mentioned when I discussed the OROCA altitude depicted on IFR en route charts. If emergencies arise the GPS makes it easy to locate the nearest suitable airports and facilities, navigation aids (including VORs and NDBs) so be sure you know how to use these features on the GPS because when you are off published airways and going down for the count your job is going to be tough so be prepared. Flying direct routes requires less fuel and makes the en route time shorter, always a benefit. The GPS also has a terrain layer that can be displayed if required to aid in terrain avoidance (much like using a VFR sectional chart).

Okay we have covered the most important parts of understanding critical portions of route selection using published airways. Always use published airways when possible as they provide the pilot an abundance of information for safe flight.

NAVIGATION BY VOR

Any time a pilot takes off on a flight it is necessary to understand how to navigate. Navigation goes as far back as man using any means of travel by land, sea, or now air to leave a point of departure and reach a destination. Stars are one type of reference used by navigators, especially those at sea. Even modern day aircraft have a means to sight the stars as a backup for navigation. Eventually the invention of the compass became a simple but useful means of maintaining a proper course still present in modern aircraft today. If over land, prominent land marks would allow navigators to keep a true course. Today, modern navigation is conducted using many land based radio navigation signals and by more advanced non-land based systems like inertial navigation systems (INS) and satellite global positioning systems (GPS). One such land based system of navigation is Variable omni-range (VOR) transmitters. These are very common today and have been used to establish a world-wide network of airways for pilots to navigate by. Even the older (and cheaper) non-directional beacons (NDB) remain in place to be used to aid in approaches for landing aircraft and simple navigation. Each of these systems requires a unique knowledge and skill for the pilot to successfully use them to reach their destination. In this section I'll discuss the VOR navigation system that is used world-wide.

TUNING THE NAVIGATION (VOR) RECEIVER

To start using a VOR for navigation the pilot must first tune to the proper frequency for the VOR to be used.

Figure 133 - The NAV1 (VOR1) tuner (receiver).

If you look at figure 133 you will notice there are two frequencies displayed 110.80 and 108.70, the second frequency (108.70) referenced as the "standby" frequency, and 110.80 referenced as the "active" frequency. When tuning a new frequency the pilot spins the knobs to enter the frequency into the standby frequency display (in flight simulator the pilot clicks on the proper "hot spots" to tune the frequency digits left of the decimal or right of the decimal). Once entered correctly and ready for use the pilot clicks the double arrow which will "swap" the frequencies in the display. In this case if the swap button were pressed 108.70 would be shown as the active frequency (on the left) and 110.80 would become the standby frequency (on the right). Most cockpits have a second receiver (NAV2) that is tuned exactly the same way. The reason for designing the receiver like this is so the pilot can quickly change back to the previous frequency without forgetting what it was. The last frequency used remains in the standby display until a new one is entered.

After tuning a navigation receiver you should always turn on the audio and verify you have tuned the correct navigation transmitter by listening to the Morse code identifier played repeatedly on the frequency.

Figure 134 - Cockpit audio panel with the NAV1 audio switch turned on.

A	.-	N	-.	1	.----
B	-...	O	---	2	..---
C	-.-.	P	.--.	3	...--
D	-..	Q	--.-	4	....-
E	.	R	.-.	5	.....
F	..-.	S	...	6	-....
G	--.	T	-	7	--...
H	....	U	..-	8	---..
I	..	V	...-	9	----.
J	.---	W	.--	0	-----
K	-.-	X	-..-		
L	.-..	Y	-.--		
M	--	Z	--..		

Figure 135 - The Morse code.

The Morse code identifiers are noted on the maps and charts pilots use. In figure 136 below if you tune NAV1 to receive the Olympia (OLM) VOR then turn on the audio for NAV1 (as shown in figure 134) you should hear the Morse code identifier (a sequence of dots and dashes) that represent the letters OLM as per the chart in figure 135.

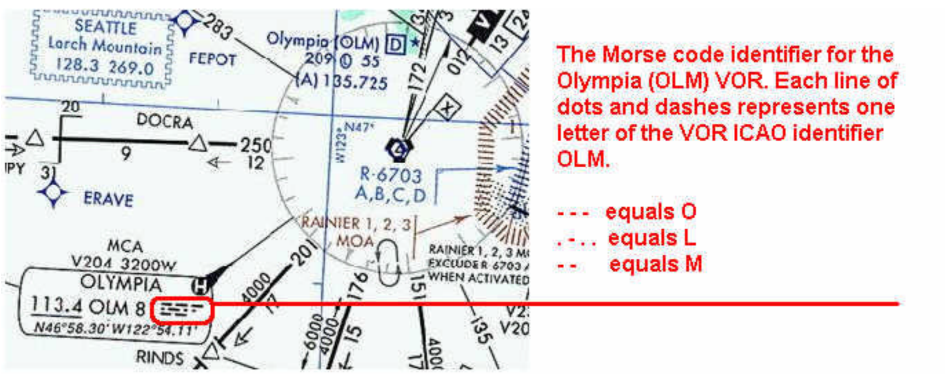


Figure 136 - The Morse code identifier for Olympia (OLM) VOR.

This is very important especially when flying IFR to keep from getting confused or even lost because the wrong signal is received and tracked (trust me this is a lesson from the "school of hard knocks" <grin>). Morse code identifiers are used for most aeronautical navigational aids.

DIFFERENCES BETWEEN THE VOR1 AND VOR2 GAUGES

There are two major differences to be noted between the NAV1 and NAV2 receivers in flight simulator. First, the NAV1 receiver linked to the VOR1 gauge (depicted in figure 137) serves as the gauge used to conduct an ILS approach. The VOR1 gauge has an extra needle (the horizontal needle) which serves as a glide slope deviation indicator. I'll discuss the use of this gauge during an ILS approach discussion later in the manual. For now it should be understood the NAV1 receiver and VOR1 gauge has a dual capability, one for lateral navigation and another for conducting a precision instrument approach which includes vertical guidance.

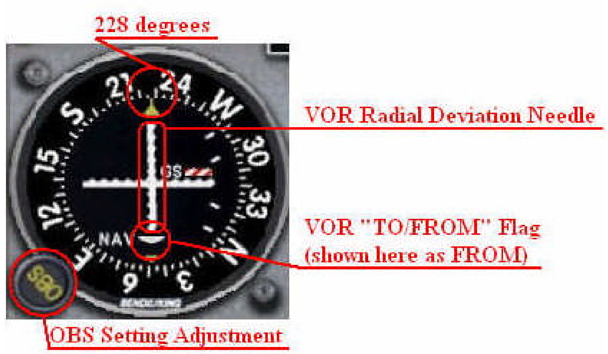


Figure 137 - Basic elements of the VOR gauge.

The second difference is the NAV1 receiver is normally the only NAV receiver that can be coupled to the autopilot via the autopilot NAV mode (the GPS can also be coupled to the autopilot via the NAV mode using the NAV/GPS source switch, more on this later). In other words the pilot can command the NAV1 receiver to control the autopilot for lateral guidance of the aircraft.

Normally the NAV2 receiver in the simulator will not couple to the autopilot so if the pilot chooses to track a VOR radial using the NAV2 receiver then it must be done either using the autopilot HDG mode or via "white knuckles" by the pilot (white knuckles or iron knuckles is an older reference for a pilot hand flying the aircraft). The HDG mode on the autopilot panel will cause the aircraft to fly in the direction set by the DG heading "bug" (the "bug" is the movable arrow on the directional gyro set by using the HDG knob).

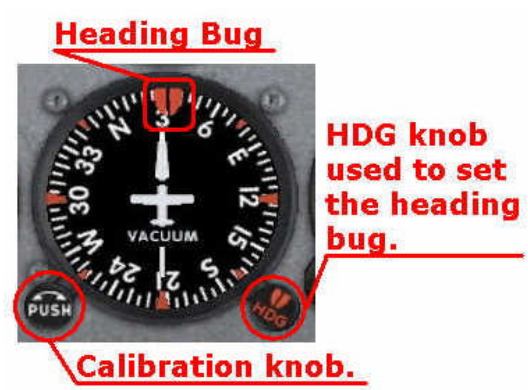


Figure 138 - Elements of the Directional Gyro (DG).

Typically the NAV2 receiver and VOR2 gauge in flight simulator aircraft do not have the dual capability that the NAV1 receiver and VOR1 gauge has and can only be used for lateral navigation (though it can be used to manually conduct a non-precision localizer approach also discussed later in the manual). Again when I say manually I mean using the autopilot HDG mode or by hand flying the aircraft, remember that the NAV2 receiver will not couple to the autopilot.

GYRO DRIFT

If at any time the pilot couples the autopilot to the directional gyro (DG) for lateral guidance using the HDG mode then another factor comes into play that the pilot must constantly watch out for, "gyro drift". Gyro drift is a result of precession caused by friction in gyro bearings and other technical reasons. Basically this type of precession throws the gyro "out of whack" and the pilot must occasionally calibrate (reset) the gyro to the magnetic compass so that the DG will display the correct aircraft heading. If this is not done then the aircraft can be steered off course by either the pilot or the autopilot.

The flight simulator realism settings provide a way for the pilot to simulate the gyro drift property or shut it off (I recommend it be left on especially in the smaller general aviation aircraft where this trait is very common to deal with in real-life). If you would rather not deal with it than make sure to uncheck the Gyro Drift option as seen in figure 139.

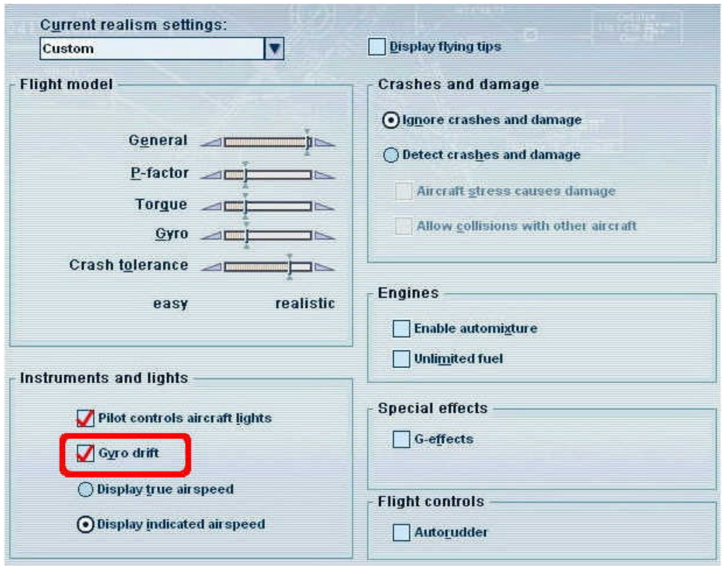


Figure 139 - FS9 realism settings.

When the gyro drift property is turned on the pilot will be required to periodically calibrate the DG using the calibration knob labeled PUSH (reference figure 140) to the aircraft compass reading. Pressing the keyboard D key will calibrate the DG automatically just like pressing the keyboard B key sets the altimeter barometric setting automatically. In real-life the DG is only calibrated while the aircraft is in straight and level flight using the magnetic compass, never when climbing, ascending, or making turns.

Figure 140 - Aircraft Directional Gyro (DG).

HOW TO TRACK VOR RADIALS

Once a NAV receiver is properly tuned and picking up a VOR transmitter the pilot can turn the OBS knob on the VOR gauge to a specific radial to be tracked. Look at figure 141 which depicts a top-down view of VOR radials using 10 degree increments (VOR radials actually use 1 degree increments). I’ll create an example using figure 141 to explain how a pilot tracks TO or FROM a VOR station.

First the pilot needs to understand an operational trait about the VOR gauge when dialing the OBS knob to center the course deviation needle (CDI) when a VOR transmitter is being received. Using figure 141, if the aircraft is located anywhere along the red line between point A and point B and the OBS knob is set to either 228 or 048 degrees the CDI will center.

In other words *the needle will always center itself twice when turned 360 degrees while an active VOR signal is being received depending on the relative location of the aircraft along a specific line (in the following examples I'll be talking about the red line in figure 141).*

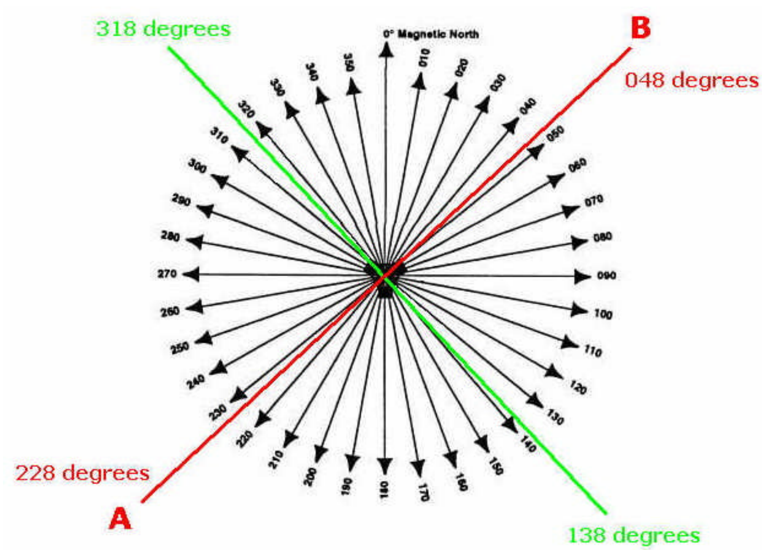


Figure 141 - Top-down view of the radials emitted from a VOR station.

So when the pilot has the CDI centered (either on the 228 or 048 degree OBS setting) the pilot will know the aircraft is somewhere on the red line depicted in figure 141, but how can the pilot narrow down where on the line the aircraft is located? In other words how is a pilot to know where the aircraft is in relation to the VOR station in this case, is the aircraft on the red line southwest or northeast (divided at the green line) of the VOR station located at the center of figure 141? How does the pilot figure out which heading to turn the aircraft on and get going on the intended course either inbound or outbound?

These are all good questions. To sort them out let's tackle it from the perspective of tracking inbound or outbound from the VOR station. Most pilots learn to understand the meaning of tracking inbound or outbound to any given fix, waypoint, or navigational aid. So, how many possibilities do we have here in figure 141?

If the aircraft is located at point A the pilot can track inbound or outbound from that point. If the aircraft is located at point B the pilot can again track inbound or outbound from that point. So we have four possibilities to track a radial using the VOR station. Let's take them one at a time.

1. Starting with the aircraft located at point A let's say the pilot wishes to track outbound away (FROM) the VOR. Any time you wish to track outbound FROM a VOR you must turn the OBS setting until the CDI centers with a FROM flag indication (*remember that the CDI always centers twice when turned 360 degrees*), the only difference between the two times it will center is the TO/FROM flag will indicate *TO one time and FROM the other*. So with the aircraft located at point A the needle will center once with a FROM indication.

   In this example when the CDI needle centers on the VOR gauge when 228° is shown under the yellow bearing arrow at the top of the gauge the aircraft is on the 228° radial. At this same moment let's say the aircraft is paused (not moving) and suspended in mid air. *No matter what direction the aircraft is pointed the CDI will center itself*. The VOR gauge doesn't know or care what direction the aircraft is headed, it is only telling the pilot which VOR radial the aircraft is located on (in this case the 228° radial).

So, how do you know what side of the VOR you're on (either the southwest or northeast side with reference to the dividing green line)? This is where the TO/FROM flag comes into play. With the aircraft located at point A and 228 degrees showing on the OBS heading to center the CDI needle and the TO/FROM flag indicating FROM you are on the same side of the VOR as the 228° radial. So the pilot will now know the aircraft is somewhere on the red line southwest of the VOR station along the red line toward point A (using the center of figure 141 where the red and green lines meet to depict the station). Why? Because the FROM flag always indicates the radial dialed in using the OBS knob is on the *same* side of the VOR the aircraft is located in reference to the dividing green line.

So the pilot knows now what VOR radial the aircraft is on and which side of the VOR station the aircraft is located on, so to track outbound on this specific radial what direction must the aircraft travel? Well, if the aircraft is put back in motion and the pilot turns the aircraft immediately to 228 degrees with the FROM flag shown the aircraft will travel away FROM the VOR on the 228 degree radial if the needle is kept centered.

So the lesson in this case is if the pilot wishes to track outbound the OBS must be turned to center the CDI with a FROM flag indication and then turn the aircraft to the bearing shown under the OBS heading arrow. If the VOR gauge CDI starts to deviate from the center, all the pilot has to do to stay on the selected VOR radial is to turn the aircraft toward the direction the CDI deviates (either left or right). The correction required depends on how close the aircraft is to the VOR, wind direction and speed and the amount of deviation noted on the gauge.

2. Next let's say the aircraft is again located at point A but in this case the pilot wishes to track inbound TO the VOR. Any time you wish to track inbound TO a VOR you must turn the OBS setting until the CDI centers with a TO flag indication.

   In this case if the CDI needle centers on the VOR gauge when 048° is under the yellow bearing arrow at the top of the gauge the aircraft is on the 048° radial. At this same moment let's again say the aircraft is paused (not moving) and suspended in mid air. No matter what direction the aircraft is pointed the CDI will center itself. The VOR gauge doesn't know or care what direction the aircraft is headed, it is only telling the pilot which VOR radial the aircraft is located on (in this case the 048° radial).

   The next thing to find out is what side of the VOR station the aircraft is on (either the southwest or northeast side with reference to the dividing green line). This is where the TO/FROM flag comes into play again. With the aircraft located at point A and the CDI needle centered with 048° showing as the OBS setting the TO/FROM flag will indicate TO. So the pilot will now know the aircraft is somewhere on the red line southwest of the VOR station toward point A. Why? Because the TO flag always indicates the radial dialed in using the OBS knob is on the *opposite* side of the VOR the aircraft is located in reference to the dividing green line.

   So once again the pilot knows what VOR radial the aircraft is on and which side of the VOR station the aircraft is located on, so to track inbound what direction must the aircraft travel? Well, if the aircraft is put back in motion and the pilot turns the aircraft immediately to 048° the aircraft will travel TO the VOR station.

   So the lesson in this case is if the pilot wishes to track inbound the OBS must be turned to center the CDI with a TO flag indication and then turn the aircraft to the bearing shown on the OBS heading. If the VOR gauge CDI starts to deviate from the center, all the pilot has to do to get back on course is to turn the aircraft toward the direction the CDI deviates (either left or right). The correction required depends on how close the aircraft is to the VOR, wind direction and speed and the amount of deviation noted on the gauge.

3. Now let's move the aircraft to point B and say the pilot wishes to track outbound away FROM the VOR from this point. Just like in example number 1 above any time you wish to track outbound FROM a VOR you must turn the OBS setting until the CDI centers with a FROM flag indication.

   In this case if the CDI needle centers on the VOR gauge when 048° is under the yellow bearing arrow at the top of the gauge the aircraft is on the 048° radial. At this same moment let's say the aircraft is again paused (not moving) and suspended in mid air. No matter what direction the aircraft is pointed the CDI will center itself. The VOR gauge doesn't know or care what direction the aircraft is headed, it is only telling the pilot which VOR radial the aircraft is located on (in this case the 048° radial).

   The next thing to find out is what side of the VOR station the aircraft is on (either the southwest or northeast side with reference to the dividing green line). Again this is where the TO/FROM flag comes into play. With the aircraft located at point B and 048° dialed into the OBS setting the TO/FROM flag will indicate FROM. Why? Because the FROM flag always indicates the radial dialed in using the OBS knob is on the *same* side of the VOR the aircraft is located in reference to the dividing green line.

   So the pilot knows what VOR radial the aircraft is on and which side of the VOR station the aircraft is located on, so to track outbound what direction must the aircraft travel? Well, if the aircraft is put back in motion and the pilot turns the aircraft immediately to 048° the aircraft will travel away FROM the VOR.

   So the lesson in this case is if the pilot wishes to track outbound the OBS must be turned to center the CDI with a FROM flag indication and then turn the aircraft in that direction. If the VOR gauge CDI starts to deviate from the center, all the pilot has to do to get back on course is to turn the aircraft toward the direction the CDI deviates (either left or right). The correction required depends on how close the aircraft is to the VOR, wind direction and speed and the amount of deviation noted on the gauge.

4. Finally let's say the aircraft is again located at point B but in this case the pilot wishes to track inbound TO the VOR. Any time you wish to track inbound TO a VOR you must turn the OBS setting until the CDI centers with a TO flag indication.

   In this case if the OBS needle centers on the VOR gauge when 228° degrees is under the yellow bearing arrow at the top of the gauge the aircraft is located on the 228° radial. At this same moment let's again say the aircraft is paused (not moving) and suspended in mid air. No matter what direction the aircraft is pointed the CDI will center itself. The VOR gauge doesn't know or care what direction the aircraft is headed, it is only telling the pilot which VOR radial the aircraft is located on.

   The next thing to find out is what side of the VOR station the aircraft is on (either the southwest or northeast side with reference to the dividing green line). This is where the TO/FROM flag comes into play again. With the aircraft located at point B and 228° shown on the OBS heading the TO/FROM flag will indicate TO. Why? Because the TO flag always indicates the radial dialed in using the OBS knob is on the *opposite* side of the VOR the aircraft is located in reference to the dividing green line.

   So once again the pilot knows what VOR radial the aircraft is on and which side of the VOR station the aircraft is located on, so to track inbound what direction must the aircraft travel? Well, if the aircraft is put back in motion and the pilot turns the aircraft immediately to 228° the aircraft will travel TO the VOR station.

So the lesson in this case is if the pilot wishes to track inbound from point B the OBS must be turned to center the CDI with a TO flag indication and then turn the aircraft to the bearing shown on the OBS setting. If the VOR gauge CDI starts to deviate from the center, all the pilot has to do to get back on course is to turn the aircraft toward the direction the CDI deviates (either left or right). The correction required depends on how close the aircraft is to the VOR, wind direction and speed and the amount of deviation noted on the gauge.

Now this may seem like overkill right? Maybe, what if I asked you what could go wrong in each of the four examples given, could you answer that? Well, I won't keep you in suspense. Let's find out exactly what could happen.

1. In example number 1 above what if the pilot had dialed the OBS setting to center the CDI but didn't note the indication of the TO/FROM flag. What if the pilot started tracking the centered CDI with the TO/FROM flag indicating TO (instead of FROM)? Well, if the CDI were to start to deviate from center and the pilot turned the aircraft toward the deviation indicated the aircraft would actually travel further away from the radial. For instance, if the CDI deviates to the left then the pilot should normally turn left toward the needle as explained in all four examples above, but because the pilot has failed to note the indication of the TO/FROM flag which in this case is TO (where it should be FROM) the sensing of the needle is reversed which will cause the aircraft to travel away from the intended radial to be tracked.

2. In example number 2 above if the pilot dialed the OBS setting to center the CDI but didn't note the indication of the TO/FROM flag being FROM instead of TO then again the CDI sensing is reversed which will cause the aircraft to travel away from the intended radial to be tracked when the pilot turns the aircraft toward the needle when it deviates from center.

3. In example number 3 above if the pilot dialed the OBS setting to center the CDI but didn't note the indication of the TO/FROM flag being TO instead of FROM then once again the CDI sensing is reversed which will cause the aircraft to travel away from the intended radial to be tracked when the pilot turns the aircraft toward the needle when it deviates from center.

4. In example number 4 above if the pilot dialed the OBS setting to center the CDI but didn't note the indication of the TO/FROM flag being FROM instead of TO then once again the CDI sensing is reversed which will cause the aircraft to travel away from the intended radial to be tracked when the pilot turns the aircraft toward the needle when it deviates from center.

So, this reverse sensing of the CDI needle is what will typically get a pilot into trouble when navigating by a VOR. The first symptom typically noticed is the needle deviating further out even as more correction is applied (which will cause the pilot to start scratching the old noggin <grin>). So here are some steps to get your VOR gauges working correctly for you.

1. Tune the NAV1 or NAV2 receiver to the VOR to be used.
2. Identify the VOR transmitter you tuned by checking the Morse code identifier on the appropriate chart or map to what you hear played with the audio turned on.
3. If you need to track TO the VOR always turn the OBS setting until the CDI centers with the TO/FROM flag indicating TO, then turn the aircraft to the bearing indicated under the VOR gauge arrow. Turn toward the needle to correct deviations from the dialed course.

4. If you need to track FROM the VOR always turn the OBS setting until the CDI centers with the TO/FROM flag indicating FROM, then turn the aircraft to the bearing indicated under the VOR gauge arrow. Turn toward the needle to correct deviations from the dialed course.

Okay, I'll explain tracking TO and FROM a VOR straight through to make sure everything makes sense. In this case the pilot is hand flying the aircraft. Looking at figure 142 let's say the pilot wishes to track from point A to point B along the red line using the VOR depicted. Let's say point A is where the pilot first starts picking up the VOR signal and wishes to track inbound to it.

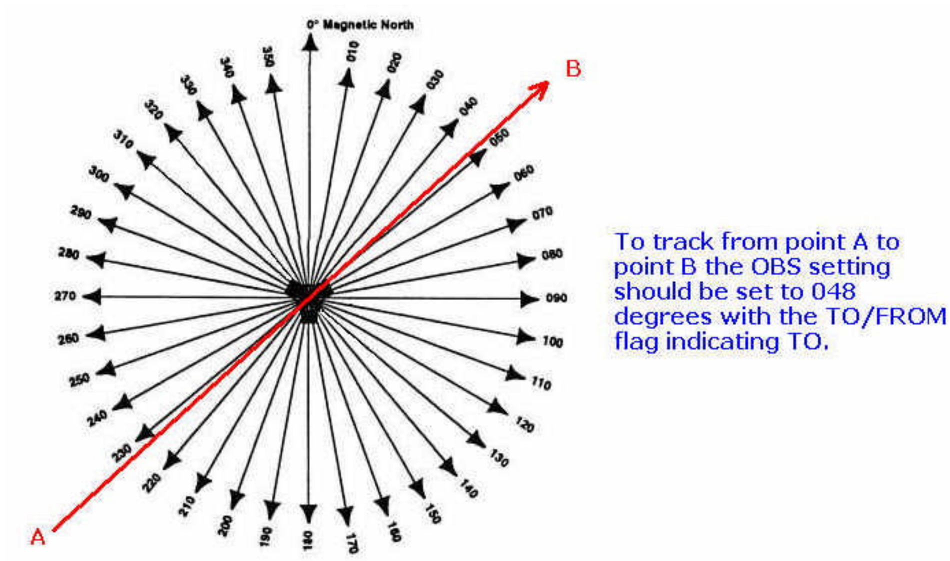


Figure 142 - Tracking a VOR radial from point A to point B.

The pilot is using the NAV1 receiver and tunes it to the frequency for the VOR transmitter and checks it by turning on the NAV1 audio and comparing the Morse code heard with that shown on the navigation maps being used. The pilot then turns the OBS knob until the CDI centers with the TO/FROM flag indicating TO and then looks at the VOR gauge arrow to see what the bearing is (in this example 048°). The pilot turns the aircraft to a heading of 048° as seen on the directional gyro (DG) and starts tracking TO the VOR station keeping the needle centered.

Now let's say the wind is blowing out of the north at 355° at 30 knots. The aircraft is drifting to the south and the CDI starts to deviate to the left (indicating the aircraft is drifting south of the radial being tracked) so the pilot turns the aircraft slightly to the left (say 5°) to compensate for the wind direction and speed. As the pilot watches the CDI, the needle has not stopped drifting completely to the left so again the pilot applies more correction, this time a bit more to compensate for the wind (say 10°) but to also return to the proper radial (or ground track). Once the needle is again centered the pilot now keeps the aircraft turned slightly to the left into the wind to keep the CDI centered (maybe about 8°).

As the pilot crosses over the VOR transmitter the TO/FROM flag will "flip" to indicate FROM. The aircraft is now traveling away (FROM) the VOR toward point B. The pilot in this case maintains the heading of 048° and keeps the current correction (the slight left turn into the wind) to keep the aircraft traveling along the proper radial (in this case still 048°) FROM the VOR.

One of the greatest advantages of the VOR system over NDB systems is that by properly tracking a VOR radial the pilot can easily fly a straight line over the ground by keeping the CDI centered. By keeping the CDI centered the pilot has already compensated for the winds. The amount of "crab" (the turn required into the wind) to stay on course will be noticed by comparing the heading shown on the DG while staying on the radial being tracked. As shown in figure 142 it might not be unusual for the pilot to maintain a heading of 030° to compensate for the prevailing wind direction and speed at altitude (as in our example here with the wind out of the north) but still fly a straight line on a heading of 048° across the ground.

DISTANCE MEASURING EQUIPMENT (DME)

VOR transmitters can be collocated with distance measuring equipment (DME) providing another great advantage to properly track the aircrafts current location, especially when the pilot has become lost or disoriented during flight. By using a single VOR that has DME capability (typically a VORTAC or TACAN) the pilot can locate the exact position of the aircraft without cross bearings from two or more transmitters. Using the techniques described above about VOR radials the pilot can turn the OBS setting to center the CDI with a TO/FROM flag indication of FROM to determine which direction the aircraft is FROM the VOR and then by using the DME reading the exact distance in nautical miles from the VOR transmitter. This will be enough to determine the exact location of the aircraft.

For example, look at figure 143 and point X. Let's say the pilot is disoriented or lost and doesn't realize the aircraft is at point X. For the pilot to determine the exact location of the aircraft a nearby VORTAC would need to be tuned (the pilot should at least know the approximate region the aircraft is located and be able to pick a VORTAC within range). When an active VORTAC is received the pilot adjusts the OBS setting until the TO/FROM flag indicates FROM with the needle centered. In this case we'll say the needle centered on the 310 degree radial with a FROM indication as seen in figure 143. Then make sure the correct NAV receiver is selected on the DME unit (reference the R1/R2 switch in figure 144 that will allow you to read from the NAV1 or NAV2 receiver if DME capable) and read the distance in nautical miles from the transmitter. The pilot can then take a navigation map and using a special plotter that can measure nautical miles plot the distance from the VORTAC on the dialed radial and know the exact position of the aircraft in relation to the transmitter.

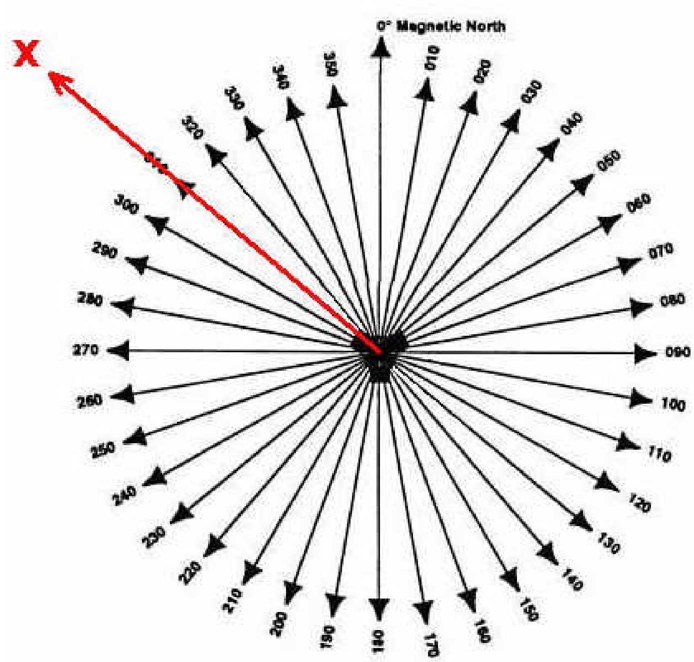


Figure 143 - Finding an aircraft at point X.

An aircraft must have a DME receiver to provide the pilot distances. A typical DME unit might look like figure 144. Here the DME unit shows the aircraft to be 8.4nm from the VOR transmitter. If you notice the DME unit can be linked to either the NAV1 or NAV2 receivers via the R1 or R2 switch previously mentioned. There is also a switch just below the "nm" in the display that will change the display to provide the pilot with different types of information. The DME unit can provide ground speeds, time to station, and more.

Figure 144 - Typical DME unit.

NOTE ABOUT SLANT RANGE

Distance measurements using a DME are exact but may fool you as it measures the distance from the aircraft straight to the transmitter including the distance in altitude and is referenced as *slant range*. In other words if a transmitter is located at an altitude of 0 feet AGL and the aircraft is located directly over head at approximately 6,072 feet AGL then the slant range (or displayed range) is going to be close to 1nm (1nm = approximately 1.15 statute mile). So a pilot will most likely never see the displayed range go to zero and if they do they are already in deep karma <grin>. Typically, depending on the aircraft altitude the distance will decrease as the aircraft approaches the VOR transmitter to a distance equivalent to the shortest slant range (somewhere overhead the transmitter) and then start increasing again as the aircraft passes the VOR and travels away from the transmitter.

PASSING A VOR STATION

I need to mention one last operational trait about the NAV1 receiver when it is coupled to the autopilot for lateral navigation before taking you on an example flight. It is important to note that when the aircraft crosses over a VOR the autopilot will automatically uncouple from the NAV mode which is normal. So if the pilot is unaware of this trait then it will become brutally apparent when the aircraft is discovered going off course for no reason (because the autopilot is not receiving any lateral guidance at all). So what is the pilot to do? If the pilot will be crossing a VOR and using the same VOR to track outbound then make sure to wait until the flag indicator has flipped to FROM and then click the NAV button on the autopilot to couple the NAV1 receiver again.

Just a tip here, when navigating by VOR transmitters and using the autopilot, when you approach a VOR turn the heading bug on the DG to match the current heading. Just before reaching the VOR couple the autopilot to the DG using the HDG mode and manually navigate TO the VOR and upon crossing the VOR set the heading bug to the outbound heading and get the aircraft on the proper outbound VOR radial. This way if you do have a course change while crossing the VOR (a different outbound heading than you had inbound) you can lead the turn slightly keeping the aircraft well within the any airway boundaries. Once established on the proper VOR radial outbound (making sure the TO/FROM flag has flipped to indicate FROM) couple the NAV1 receiver back to the autopilot using the NAV mode. This will make the process of crossing the VOR occur without any glitches.

VOR DEMONSTRATION FLIGHT

I'll now discuss a short flight using VOR transmitters. Using the default Cessna 182 Skylane this is a 2 hour and 35 minute VFR flight from Columbia SC to Cape Hatteras NC (298.4nm total distance). The route will have four VORs with an intermediate intersection named WALLO between the Fayetteville and New Bern VORs (that you will find via cross bearings between the two VORs). The flight plan is as follows:

WAYPOINTS	HDG	LEG/REM	GS (KTS)	ETE/ATE
KCAE	***	00.0/298.4	***	***
MMT (113.20)	095	16.0/282.4	115	0:08/
FLO (115.20)	075	59.8/222.6	115	0:31/
FAY (108.80)	043	59.4/163.2	115	0:30/
WALLO	102	45.4/117.8	115	0:23/
EWN (113.60)	084	46.6/71.2	115	0:24/
OUC (404.0)	095	52.0/19.2	115	0:27/
KHSE	080	19.2/0	115	0:09/

Figure 145 - VFR sectional map part 1.

Just before departing Columbia Metro Airport in South Carolina tune the NAV2 receiver to pick up the Mc Entire (MMT) VOR on 113.20. Also tune the NAV1 receiver to pick up the Columbia (CAE) VOR on 114.70.

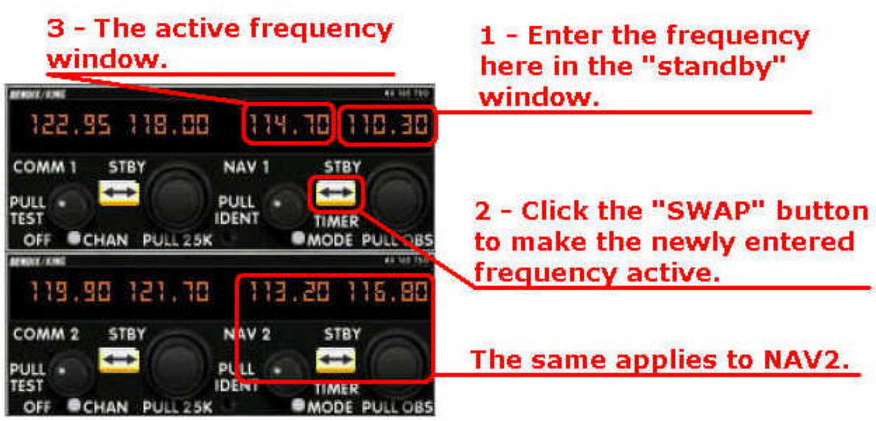


Figure 146 - Tuning the NAV receivers.

Turn the VOR1 OBS knob to put the bearing 075° above the yellow arrow at the top of the gauge.

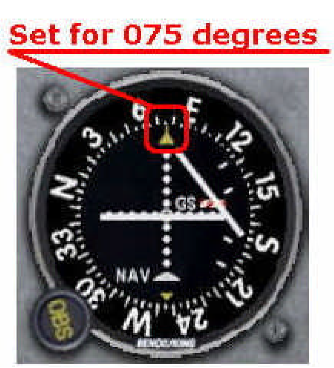


Figure 147 - Setting the NAV1 VOR gauge.

Note that you probably won't pick up the MMT VOR until just after takeoff. The INOP flag indicates no signal is being received or the gauge is unreliable. There are two INOP flags on the VOR1 gauge shown in figure 147, one for the glide slope needle (the horizontal needle) and one for the CDI (the vertical needle). The glide slope flag (GS) will show INOP, do not mistake it for the CDI flag.

Figure 148 - The VOR2 gauge INOP flag.

Make sure you have properly tuned the CAE VOR by turning on the NAV1 audio and checking the Morse code identifier before takeoff (reference the CAE VOR information circled in blue in figure 145 for the Morse code identifier). This should be possible since the NAV1 receiver should be picking up the CAE VOR. To see the chart in figure 145 better, make a print out of it or if your browser is capable zoom in on it.

Figure 149 - Listening to the NAV1 Morse code identifier.

Set the heading bug on the DG to the runway heading 050° (use runway 5 for takeoff).

Figure 150 - Using the DG as the source for autopilot guidance.

Set the autopilot for a cruise altitude of 5500 feet MSL and a climb rate of 500 feet per minute.

Figure 151 - Setting the autopilot cruise altitude and climb rate.

VFR flights with an en route heading between 000 and 179 degrees magnetic fly odd thousands plus 500 feet.

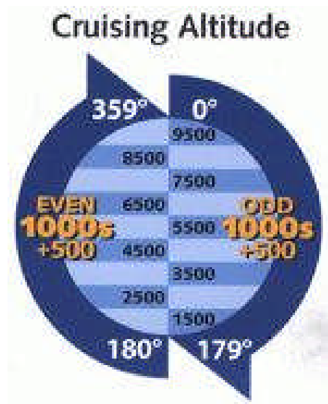


Figure 152 - Diagram of cruise altitudes for VFR pilots.

Also make sure the NAV/GPS selector switch is set to NAV (this is very important!). If this switch is in the GPS position and the autopilot NAV mode is selected then the GPS is coupled to the autopilot and provides lateral guidance. In our example flight we want to couple the NAV receiver to the autopilot (not the GPS) so select NAV on the GPS/NAV switch and then use the NAV mode on the autopilot as required.

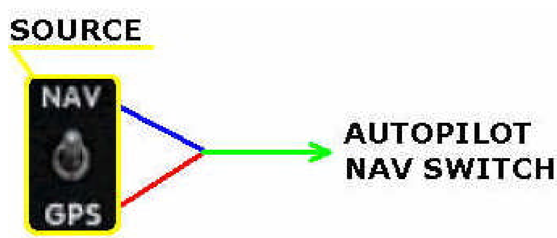


Figure 153 - Use of the NAV/GPS switch to select the navigation (NAV) source for the autopilot.

Immediately after takeoff activate the autopilot using the HDG and ALT buttons so you can get busy on the VOR stuff (you will not couple the autopilot to the NAV1 receiver just yet; only couple it to the DG for the moment using the HDG mode).

Figure 154 - Activating the autopilot to hold the selected altitude and to use the DG as the source of guidance.

Turn the NAV2 OBS knob to center the needle with a TO flag indication as previously taught. You should pick it up just after takeoff and it should indicate a bearing TO the VOR close to 095° to 110° depending on how fast you get around to setting the OBS setting after takeoff.

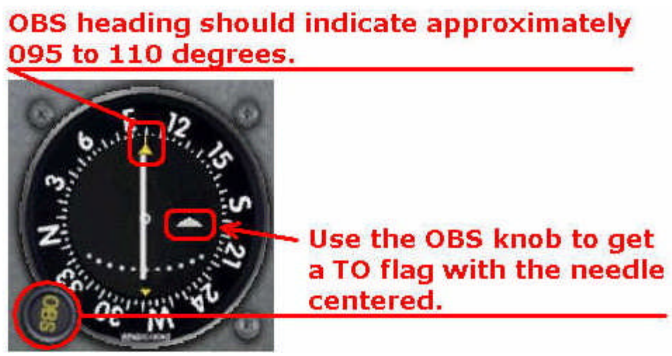


Figure 155 - Setting the VOR2 OBS bearing to center the course deviation needle (CDI) with a TO flag indication.

Turn the aircraft by readjusting the heading bug on the DG to the heading that matches the bearing shown above the yellow arrow when the VOR needle is centered with a TO flag indication (shown above in figure 155 it is 100°).

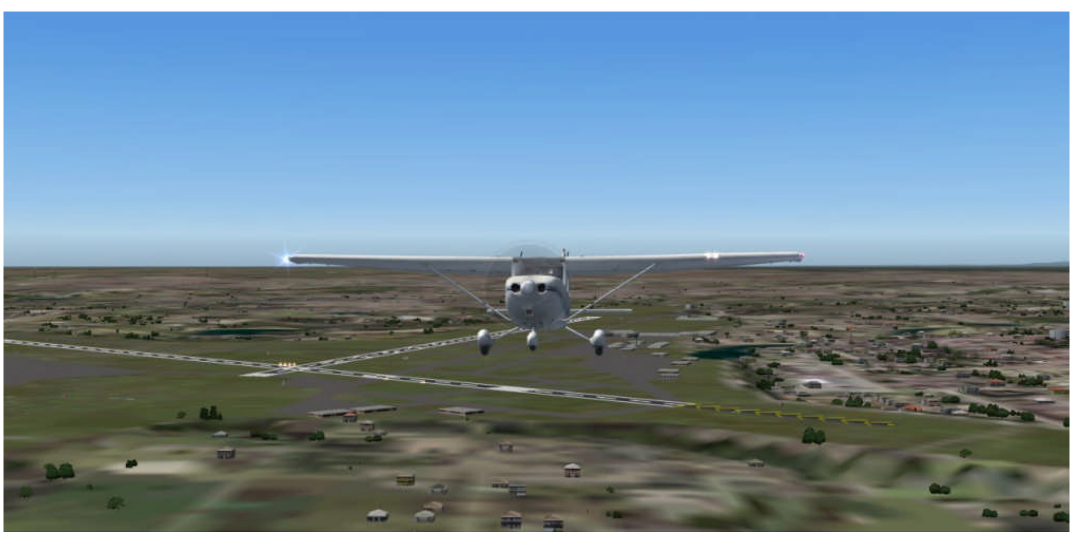


Figure 156 - Leaving Columbia Metro Airport.

Afterwards adjust the aircraft heading toward the direction of the needle (either left or right) if it deviates (most likely it will deviate to the right at first), do not readjust the OBS setting or you will not fly a straight line. Rather keep the aircraft on the bearing dialed in initially (100° in this case). Remember; if using simulated winds, wind direction and speed may cause the aircraft to drift off course so apply any necessary course corrections to keep the aircraft on the selected radial (or ground track). If there are no winds then corrections for wind drift probably won't be necessary.

Figure 157 - Downtown Columbia SC.

Make sure to turn on the NAV2 audio and properly identify the MMT VOR by checking the Morse code identifier as done above before takeoff for the CAE VOR (again reference the MMT VOR information circled in blue in figure 145).

Now as you approach the MMT VOR (via the NAV2 receiver) notice the course deviation needle (CDI) on the VOR1 gauge (for NAV1) which was deflected to the far right has slowly moved left toward the center.

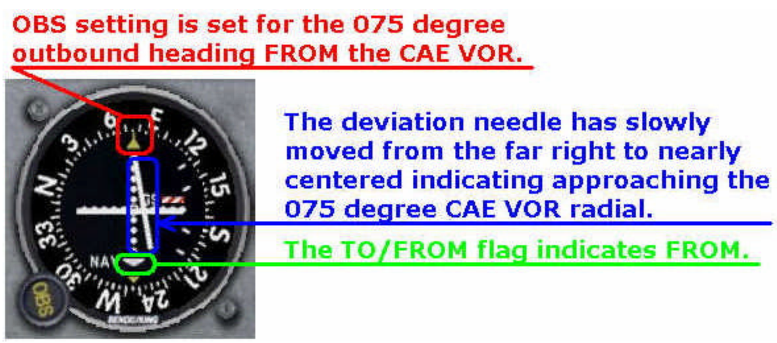


Figure 158 - Intercepting the 075° radial FROM the CAE VOR (Victor Airway 56).

This is because you are approaching the 075° radial FROM the CAE VOR. The VOR1 gauge TO/FROM flag will indicate FROM. Start turning the aircraft when the needle is approximately one dot from being centered by readjusting the heading bug on the DG to a heading of 075° to get on Victor 56 outbound from the CAE VOR. Once established on the 075° radial outbound with the VOR1 gauge needle centered and the flag indicator displaying FROM couple the NAV1 receiver to the autopilot by clicking on the autopilot NAV button.

Now you can see why we used the NAV2 receiver to track TO the MMT VOR just after takeoff by using the DG as our guidance source for the autopilot so you could couple the NAV1 receiver later once on the Victor airway outbound from CAE using NAV1 as the source. If you had been using the NAV1 receiver to track to the MMT VOR first instead of the NAV2 receiver you would have had to couple to the DG anyway and then switch the NAV1 frequency in-flight and adjust the OBS setting for the new course. It was less work and more efficient to manually track to the MMT VOR (which was only a short distance away) using the NAV2 receiver first (which will not couple to the autopilot) and intercept the 075 degree radial FROM the CAE VOR using NAV1, already setup before takeoff then coupling it to the autopilot to track the 075° radial outbound FROM the CAE VOR once reaching it.

Once tracking the CAE 075° radial outbound using the NAV1 receiver and the VOR1 gauge you can tune the NAV2 receiver to pick up the next VOR along the route, in this case that will be the FLO VOR on 115.20 and when tuned turn on the NAV2 audio to verify the correct Morse code identifier.

Figure 159 - Tuning the NAV2 receiver to pick up the next en route VOR (FLO VOR).

Since there are no intermediate intersections or turns between the two VORs the inbound radial to the FLO VOR will be the same as the outbound radial from the CAE VOR, 075°. Continue tracking the outbound radial FROM the CAE VOR using the NAV1 receiver and track the inbound radial TO the FLO VOR using the NAV2 receiver as a backup for now.

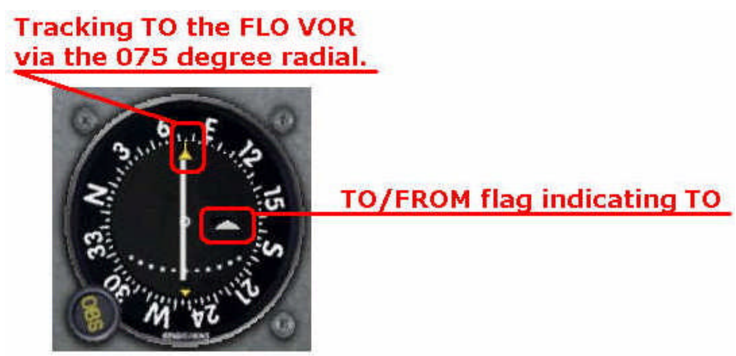


Figure 160 - Manually tracking TO the FLO VOR using the DG as the source guidance for the autopilot.

When about half way between the CAE and FLO VORs temporarily couple the autopilot back to the DG (make sure the heading bug is set to the current heading of 075°). Now tune NAV1 to pick up the FLO VOR on 115.20 just like is currently set into NAV2. The OBS setting should already be on 075° and the TO/FROM flag should now indicate TO. Couple the autopilot back to the NAV1 receiver and continue tracking toward the FLO VOR on the 075° radial.

As you approach the FLO VOR once again temporarily couple the autopilot to the DG maintaining the track along the 075° radial, while using the DG as your source for autopilot guidance readjust NAV1 for the outbound heading (043°) from the FLO VOR.

Watch the DME as you approach the FLO VOR and notice how the distance decreases, then stops as you start to cross the VOR. Make sure to select the proper source for the DME readout via the N1 (NAV1) or N2 (NAV2) select switch (in this case both VORs are currently tuned to the FLO VOR so it should not matter). After crossing the VOR the distance will once again start to climb. This is due to the slant range mentioned previously.

Figure 161 - Using the DME readout.

Crossing the FLO VOR is indicated by the TO/FROM flag "flipping" to FROM. Readjust the DG heading bug to 030° to get on the proper radial and Victor airway (you have already overshot the VOR 043° outbound radial so you need to compensate for this by turning a little further left toward the outbound heading) and once the NAV1 needle starts to center itself then couple the autopilot back to the NAV1 receiver by clicking the NAV button on the autopilot.

In this case I had you overshoot the 043° radial to show you what would happen. Typically you will lead your turns (if a turn is required) when crossing a VOR so you can "rollout" on the proper radial without turning to early or turning to late. This is how you stay within airway boundaries while en route. It is an ATC requirement to remain within airway boundaries, including when making turns en route.

Figure 162 - VFR sectional map part 2.

The next VOR along the route is the Fayetteville (FAY) VOR so tune the NAV2 receiver at this point to 108.80 and set the OBS knob so the VOR2 gauge is set for 043°. Be aware that the NAV2 receiver may not pick up the FAY VOR right away until the aircraft reaches a point midway between the two VORs.

Figure 163 - Setting the VOR2 gauge to track TO the FAY VOR en route.

Remember to identify the FAY VOR transmitter by turning on the NAV2 audio and checking the Morse code identifier once it is picked up. We will not tune NAV1 to the FAY VOR as we did with the FLO VOR. When the NAV2 receiver picks up the signal from the FAY VOR the TO/FROM flag should indicate TO. At this point temporarily couple the autopilot to the DG tracking the 043° radial on the VOR2 gauge keeping the needle centered. Remember, when tracking a VOR radial with the DG the pilot must correct for any CDI deviations as the NAV2 receiver will not do this automatically like NAV1 would when coupled to the autopilot.

With less than 1nm displayed on the DME for the distance to FAY VOR (but before crossing it) adjust the DG heading bug to 102°. This should "lead" the turn slightly so the aircraft will roll out on the outbound heading and well within the airway boundaries. Continue tracking outbound FROM the FAY VOR on the 102° radial using the DG coupled to the autopilot keeping the course deviation needle (CDI) centered.

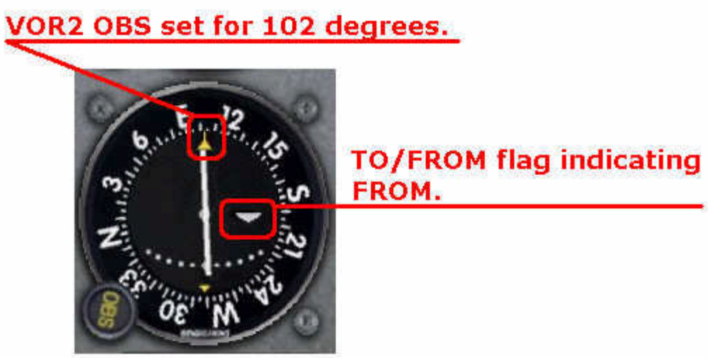


Figure 164 - Tracking outbound FROM the FAY VOR.

Once established outbound tune NAV1 to the EWN VOR on 113.60 and set the VOR1 OBS for 084°.

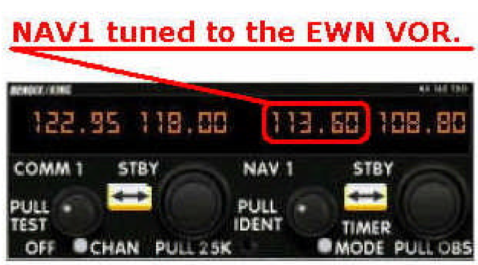


Figure 165 - Tuning NAV1 to the EWN VOR.

We now have the NAV1 and NAV2 receivers set up to locate the WALLO intersection via a cross bearing between the two VORs, FAY and EWN. As seen below the blue arrow depicts the outbound bearing FROM the FAY VOR and the green arrow depicts the inbound bearing TO the EWN VOR.

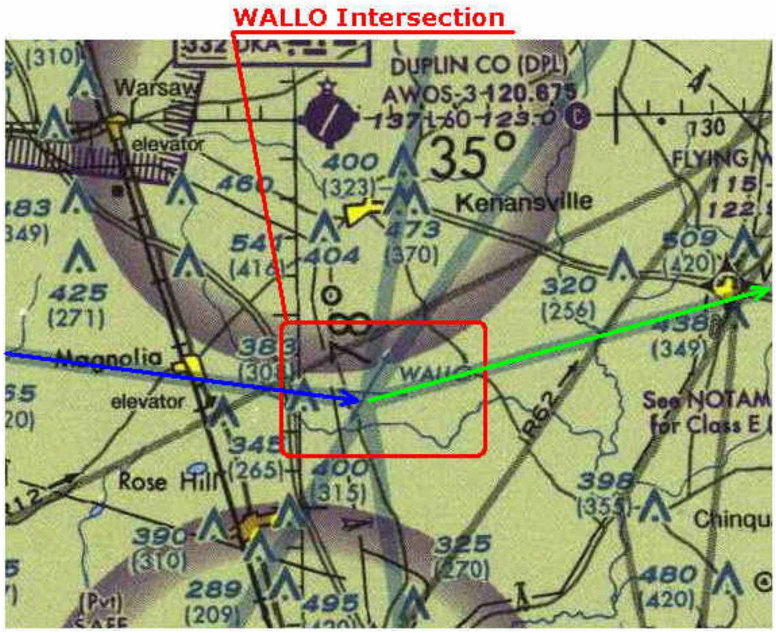


Figure 166 - How to identify the WALLO intersection.

You will have to track outbound via the FAY VOR for a bit before being able to pick up the EWN VOR which will be out of range at first. When it is picked up the VOR1 needle will be off to the right. Once again ensure you have tuned the correct transmitter by turning on the audio for the NAV1 receiver and listening to the Morse code identifier.

Figure 167 - The VOR1 gauge after picking up the EWN VOR (notice the TO flag indication).

As you approach the WALLO intersection the VOR1 needle will slowly drift back left toward the center. The VOR2 gauge should remain centered if being tracked properly (remember you are tracking this VOR radial manually using the DG). When both the VOR1 and VOR2 needles are centered you are at the WALLO intersection as seen below in figure 168.

Figure 168 - VOR1 and VOR2 CDI needles centered when reaching WALLO intersection.

At this point you can couple the autopilot back to the NAV1 receiver so it can track toward the EWN VOR as seen in figure 169. Just after clicking the NAV mode button on the autopilot the aircraft will turn to intercept the 084° radial to the EWN VOR.

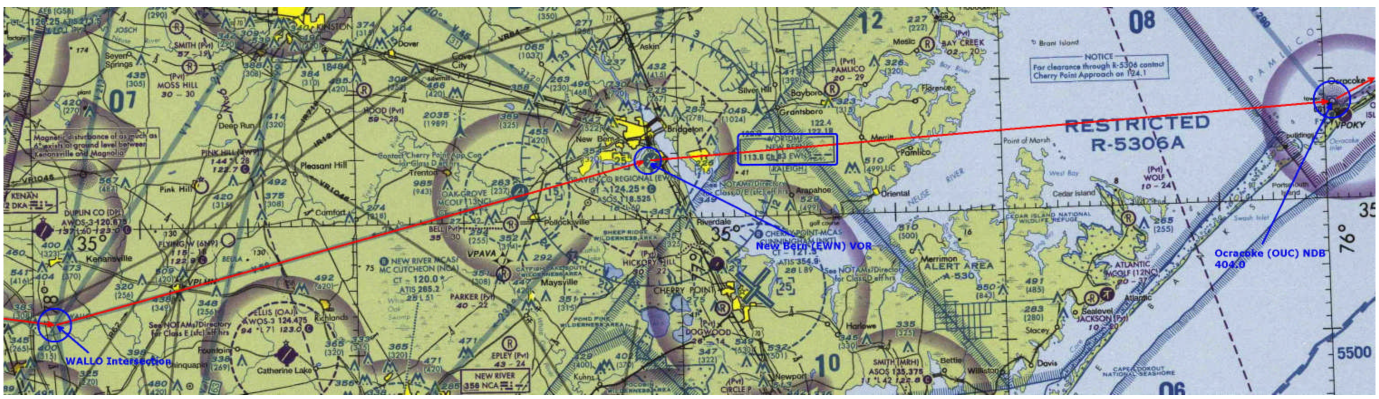


Figure 169 - VFR sectional map part 3.

When you approach the EWN VOR set the DG heading bug to 084° and temporarily couple the autopilot to the DG. Adjust the OBS setting for the VOR1 gauge for 095° and when less than 1nm from the EWN VOR, but before crossing the VOR change the heading bug to 095° (again to lead the turn into the new heading outbound FROM the VOR so the aircraft will rollout on the 095° VOR radial without over shooting it).

Figure 170 - Using the VOR1 gauge to track the 095 degree radial FROM the EWN VOR.

Once established on the radial outbound couple the autopilot back to the NAV1 receiver. This heading will take you out across the mouth of the Neuse River and the Pamlico Sound. If you like you can tune the Pamlico NDB on 404.0. I won't go into tracking the NDB inbound or outbound just yet (that is covered in the next section). Once over the Pamlico Sound you should be able to see the Ocracoke Island and the Ocracoke Island Airport near where the NDB is located. From there just fly northeast along the outer bank (or island) and the next airport to the northeast will be the Billy Mitchell Airport at Cape Hatteras NC. Happy landing!

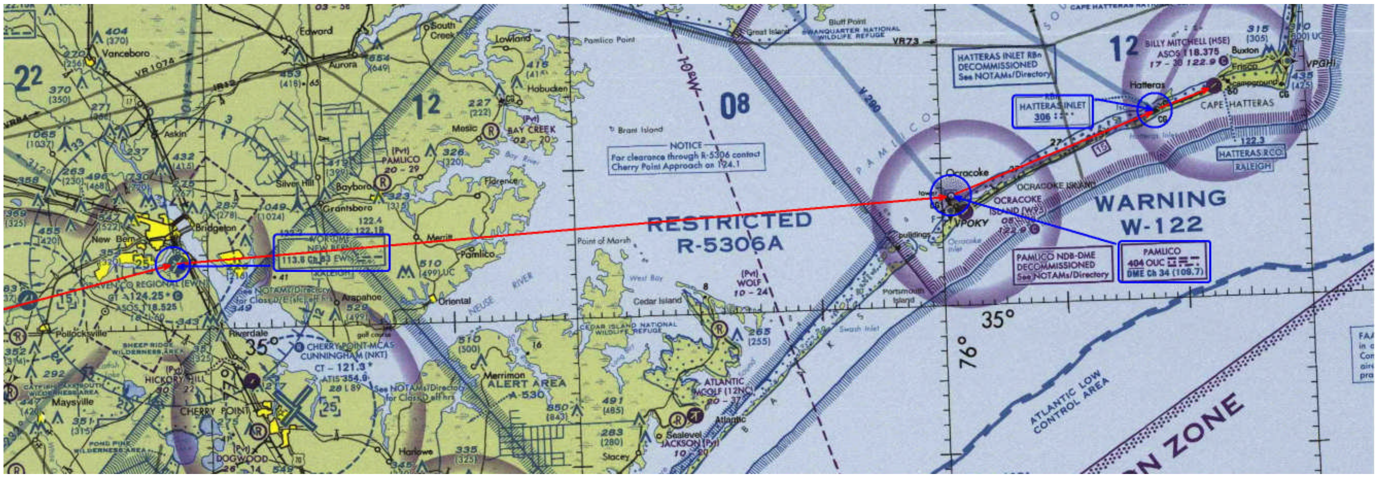


Figure 171 - VFR sectional map part 4.

This completes your orientation to using VOR transmitters for in-flight navigation. Another good way to learn more about VOR transmitters is to pick a single VOR to fly around. Tune the VOR into one of the receivers and then practice at different points around the VOR centering the needle, flying away FROM and back TO the VOR while correcting for the deviations in the needle. Make sure you understand how to properly track a single radial (bearing) TO or FROM the VOR so your aircraft heading corrections always bring the needle back to the center when the turn is toward the needle deflection.

NAVIGATION BY NDB

In early aviation pilots navigated by dead reckoning, a method of using time, speed, and sticking to a magnetic bearing to help them end up at a destination (considering if the wind and weather didn't throw a monkey wrench into the calculations <grin>). When flying at night light beacons provided a means for pilots to navigate visually between points. Light beacons can be seen for many miles on a clear night so pilots could effectively hop from one beacon to another, again as long as the weather cooperated. These methods were very unreliable, so a better way was required to overcome these hit or miss methods.

Eventually a simple radio beacon, with a constantly transmitted signal, called a non-directional beacon (NDB) was developed. The NDB signal is exactly the same as an AM radio station signal. The pilot only requires a radio receiver in the aircraft called an automatic direction finder (ADF) which provided a means for a pilot to tune into the stations (much like an AM radio). The ADF gauge linked to the receiver and a special antenna would determine the bearing the signal was strongest from providing the pilot with a bearing to the station. This allowed the pilot to "home" in on the signal and steer toward it. The pilot had to simply compensate for wind drift (the combination of wind direction and speed) to stay on a predetermined course (the plotted course line on a chart).

Because the signal from an NDB transmitter is on a lower frequency band (the NDB frequency range is between 190 to 535 KHz) they are capable of traveling along the earth's surface and provide directional guidance even in rugged terrain depending on their power output. The problem though, was that these frequencies were subject to distortion from such factors as lightning, precipitation static, other signals, even the night. Ever listen to an AM radio receiver during the day? The signal is clear and for the most part distortion free, but after the sun goes down listen again and you'll hear much more than just that one signal.

I remember listening to WOWO (a popular Fort Wayne Indiana radio station on 1190 KHz) that could be picked up all over the eastern seaboard at night on an AM radio as far south as Florida (and probably further). Radio signals on those lower frequency bands can travel hundreds if not thousands of miles at night. The interference from this night time phenomenon can cause the direction finder to go “whacky” when you least expect or want it to.

Also, the static from electrical storms can actually override a transmitted signal and cause the gauge to point more toward the storm (usually the center of a fierce thunderstorm!) and that is not where you want to steer the aircraft. Since ADF receivers do not have a “flag” to warn the pilot when erroneous bearing information is being displayed, the pilot should periodically (if not constantly) monitor the ADF audio signal when being used to ensure tracking the proper NDB signal (in simulated flying the NDB signal will always be perfect <grin>).

Eventually an even more reliable and enhanced transmitter system was developed called variable omni-range or VOR which we just discussed. These VOR transmitters are affected much less by weather because the transmitted signals are on a higher frequency making them primarily vulnerable only to line-of-sight limitations (in other words mountainous terrain presents a problem to these higher frequencies) but when congregated close enough they can overlap there signals providing reliable reception that cover entire flight routes. They are not as cheap as the simpler NDB transmitters so in many areas NDB transmitters are still used especially in more remote regions. These transmitters also allow pilots to very accurately track specific “radials” (that are really the magnetic degrees like that of a compass) oriented to magnetic north without the burden to constantly watch for and compensate for wind drift. They pilot only needs to keep the “deviation” needle on the VOR gauge centered to stay on a specific course line (a specific ground track).

TUNING AN ADF RECEIVER

To start using an NDB transmitter to navigate by, the pilot must tune the automatic direction finder (ADF) receiver to an NDB transmitter frequency (in the U.S. these frequencies range from 190 to 535 KHz). In figure 172 the frequency 404.0 is tuned.

Figure 172 - Automatic Direction Finder (ADF) receiver.

When the ADF is properly tuned to an NDB transmitter the bearing pointer on the ADF gauge will spin and point in the direction of the strongest signal received on the frequency tuned (see figure 173).

Figure 173 - The ADF gauge.

It is important to note, even though the ADF gauge does not sport an INOP flag like the VOR gauges, if the ADF is not picking up a signal the ADF pointer will lock at the 90° point as annotated in figure 174.

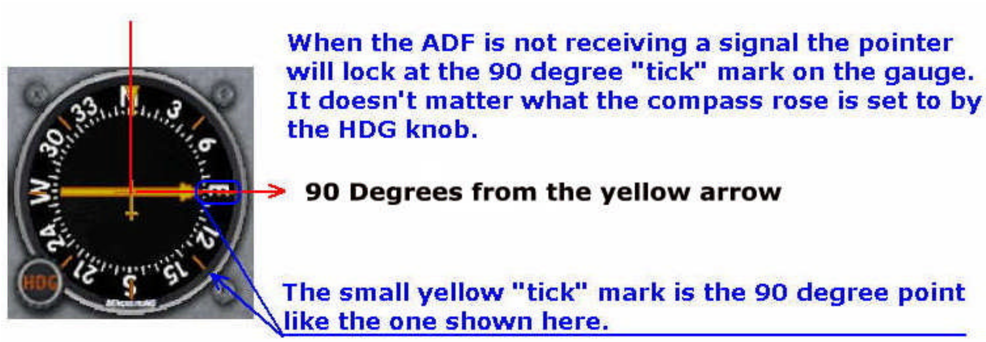


Figure 174 - The ADF pointer locked at 90 degrees when not receiving a signal.

To ensure you have tuned the station of choice and that you are receiving a strong and clear signal you must listen to it. All aeronautical navigation aids (NAVAIDs) will transmit a Morse code identifier which can be obtained from the maps and charts used for navigation. To listen to the signal the pilot must turn on the ADF receiver audio on by clicking on the ADF audio switch on the cockpit audio panel as seen in figure 175.

Figure 175 - Cockpit audio panel with the ADF audio turned on.

The Morse code output is played repeatedly over and over again. For instance, if the ICAO identifier for the NDB were UKF then the Morse code heard in the audio would be dot, dot, dash (U), dash, dot, dash (K), and dot, dot, dash, dot (F).

A	**.-**	**N**	**-.**	**1**	**.----**
B	**-...**	**O**	**---**	**2**	**..---**
C	**-.-.**	**P**	**.--.**	**3**	**...--**
D	**-..**	**Q**	**--.-**	**4**	**....-**
E	**.**	**R**	**.-.**	**5**	**.....**
F	**..-.**	**S**	**...**	**6**	**-....**
G	**--.**	**T**	**-**	**7**	**--...**
H	**....**	**U**	**..-**	**8**	**---..**
I	**..**	**V**	**...-**	**9**	**----.**
J	**.---**	**W**	**.--**	**0**	**-----**
K	**-.-**	**X**	**-..-**		
L	**.-..**	**Y**	**-.--**		
M	**--**	**Z**	**--..**		

Figure 176 - The Morse code.

One other important note about the ADF gauge, the ADF compass rose (or card) is not coupled to the DG and must be *manually* turned by the pilot using the HDG knob to match the aircraft magnetic heading using the DG to obtain a proper bearing to the NDB transmitter tuned. I'll discuss tracking TO and FROM an NDB shortly.

RADIO MAGNETIC INDICATORS (RMI)
On more advanced ADF gauges, referred to as a radio magnetic indicator (RMI), the compass rose is coupled (slaved) to the aircraft directional gyro (DG) and spins automatically to match the direction of the aircraft. The RMI usually has two separate pointers; one is a single bar arrow (the yellow arrow in figure 177) and the other a double bar arrow (the green arrow in figure 177). There are two switches on the RMI that allow the pilot to select the source to be pointed at, either the ADF signal or a NAV (VOR) signal.

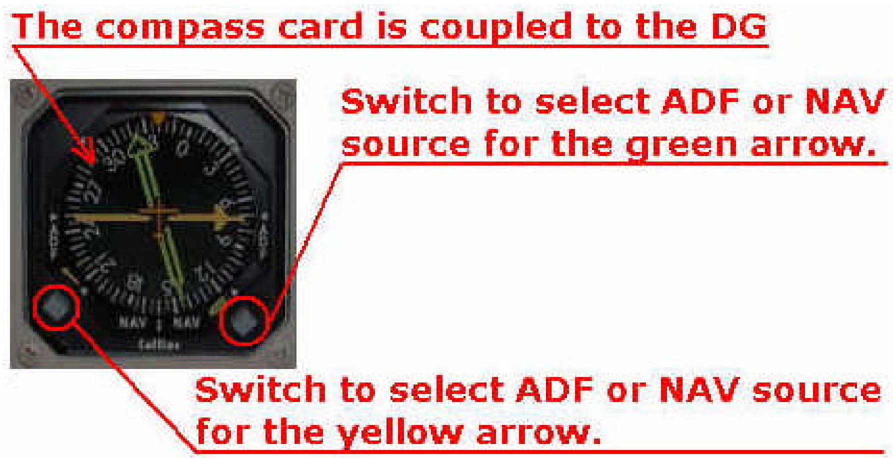


Figure 177 - Radio Magnetic Indicator (RMI).

RMIs are great to use because the pilot doesn't have to constantly set the ADF bearing to the DG heading as would be the case when using an ADF gauge. Also because the source signals can be selected via the switches you can monitor two bearings at once making it a great tool to obtain cross bearings. Note that not all simulated aircraft provide a fully functional RMI but if you're the kind of person that likes to tinker with the gauges (installing new ones and such) then RealityXP http://www.reality-xp.com/ sells a terrific instrument, the STA 3400 that can replace any non-functional RMI with their gauge and provide much more, as it functions as a TA gauge and ground terrain avoidance unit also. Figure 178 shows the gauge as an RMI, but by selecting the proper buttons you can access the many other functions it can provide.

Figure 178 - The RealityXP STA3400.

A last note of interest concerning the ADF receiver is that the receiver, in real-life, can tune into AM radio stations. Surprised, don't be, the ADF receiver is just like an AM radio receiver. As an example, when I use to fly privately and would be returning home I would typically use the ADF receiver to get a directional bearing to a hometown AM radio station for guidance to the "house" (other than the VOR receivers I had in the Cessna because we didn't have a nearby VOR transmitter). Because my hometown radio station had a high power output (1000 watts) I could receive it further out and more clearly than my airports NDB transmitter which had a lower power output. Aeronautical NDB transmitters can output power less than 50 watts and greater than 2000 watts. While tuned into my hometown radio station (a commercial broadcast station) using the ADF receiver I could also listen to music or news during the flight by turning the audio on <grin>.

TRACKING INBOUND TO AN NDB TRANSMITTER

Let's look at part of the VFR sectional map used during the demonstration flight from Columbia SC to Cape Hatteras NC for navigating by VOR transmitters. To reach the final destination at Billy Mitchell Airport we'll navigate inbound and outbound using the Pamlico NDB.

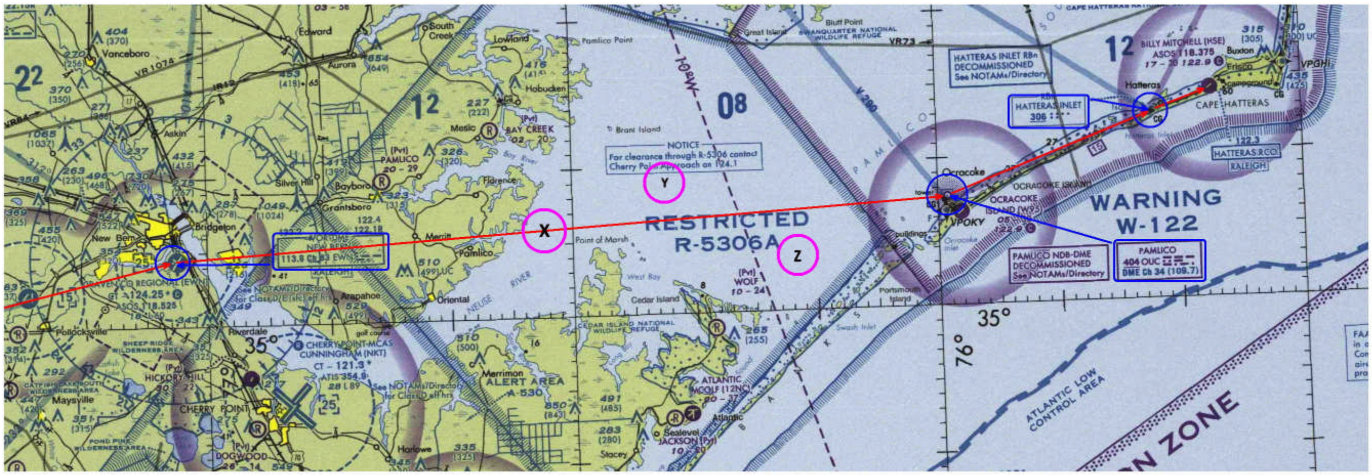


Figure 179 - VFR sectional from New Bern NC to Cape Hatteras NC.

After turning outbound from the New Bern (EWN) VOR you could continue to use the VOR 095° radial which would provide a very accurate straight line flight to the Pamlico NDB, but instead let's switch over to using the NDB as soon as we can pick it up on the frequency indicated on the chart (404.0).

Figure 180 - Tuning the ADF receiver to the Pamlico NDB.

If I want to follow the same exact straight line as indicated by the plotted red line (which is the 095° radial FROM the EWN VOR) then you must ensure some things are closely watched while using the ADF gauge.

You know the bearing from the EWN VOR to the Pamlico NDB is 095° (you can find this by looking to see where the plotted red line crosses the compass rose that circles the EWN VOR shown on the chart) so it is easy to figure out that the inbound heading to the NDB is also going to be 095°, so as long as the aircraft DG shows a heading of 095° (as in figure 181)…

Figure 181 - Directional Gyro (DG) showing a heading of 095 degrees.

…and the ADF gauge is pointing to 095° (as in figure 182), when the same bearing (heading) as shown on the DG is dialed into the ADF gauge using the HDG knob (again as shown in figure 182)…

Figure 182 - The ADF gauge set for 095 degrees and the ADF pointer indicating 095 degrees.

…then you are on the plotted course somewhere along the red line (let's say at point X located over the mouth of the Neuse River). Reference the pink circles on the sectional map in figure 179).

But what if the winds where out of the south causing the aircraft to drift north off the plotted course. Let's say you haven't been paying attention <grin> and the aircraft is now located around point Y. You think everything is okay because the DG still shows a heading of 095°, but then you look at the ADF gauge, also still set to the correct heading of the aircraft (095°) but the ADF bearing pointer is now pointing approximately at 114°. Why?

Figure 183 - ADF pointer now indicating just north of the plotted course.

This is telling you that you have drifted left of course (in this case looking at the sectional chart you are north of the plotted course say somewhere around point Y). To correct this you must now turn the aircraft to the right not only to get back onto the plotted course line but also to compensate for the wind. In this case I would turn the aircraft to approximately a 130° heading to start the correction. Make sure to readjust the HDG knob on the ADF to reflect this heading change as in figure 184.

Figure 184 - The corrective heading shown in the DG and set into the ADF gauge.

As a rule-of-thumb the amount of correction should be proportional to the distance from the NAVAID so do not make large corrections when you are close in to a NAVAID otherwise you'll just end up "chasing" the needle. The question now is how do you know when to turn back to the course heading? In other words how do you know you are back on the plotted course?

In this case the ADF bearing pointer is going to slowly move CCW. Eventually it will reach 095° as seen in figure 185.

Figure 185 - ADF pointer that has moved CCW and now pointing at 095°.

When it does point to 095° turn the aircraft back to that heading and all should be aligned (or be very close) once again (the DG heading should be on 095° and the ADF pointer should be indicating 095° after the HDG knob has once again been properly adjusted to the indicated heading on the DG as in figure 186.

Figure 186 - Back on the proper plotted course of 095°.

Note that unless you intend to drift off course again you will need to turn the aircraft slightly into the wind. If as in this example the wind is out of the south try a 5° to 10° correction depending on the wind speed, the greater the wind speed the more correction that should be applied and vice versa to fight the prevailing wind and keep the aircraft on the plotted course (ground track).

Now let's make another example and say the aircraft has drifted south off the plotted course because the prevailing winds are out of the north and is located around point Z depicted on the sectional map in figure 179. You think all is well but then you look at the NDB still set to the correct heading of the aircraft (095°) but the bearing pointer is now pointing approximately at 079° as in figure 187.

Figure 187 - ADF pointer now indicating just south of the plotted course.

This will tell you that you have drifted right of course (in this case south of the plotted course). To correct this you must now turn the aircraft to the left not only to get back onto the plotted course line but to compensate for the wind. In this case I would turn the aircraft to approximately a 060° heading. Make sure to readjust the HDG knob on the ADF to reflect this heading change as in figure 188.

Figure 188 - The corrective heading shown in the DG and set into the ADF gauge.

As you approach the plotted course the ADF pointer will slowly move CW and eventually reach 095°.

Figure 189 - ADF pointer that has moved CW and now pointing at 095°.

When it does point at 095° turn the aircraft back to that heading and all should be aligned once again (the DG heading should be on 095° and the ADF pointer should be indicating 095° when the HDG knob has been properly adjusted to the DG heading as in figure 190.

Figure 190 - Back on the proper plotted course of 095°.

Again, unless you intend to drift off course you must apply a slight heading correction to compensate for the prevailing wind. Start with 5° to 10° depending on the wind speed and watch your drift closely. If the aircraft still drifts to the south then try adding another 5° of correction (say 15°) and again watch the drift. But if the aircraft begins to overtake and cross the plotted course to the north then you know you have applied to much correction so subtract a few degrees from that applied. In this example 5° is a rule-of-thumb for starting the corrections. You may need more or less depending on the angle of the wind in relation to your plotted course and the wind speed.

TRACKING OUTBOUND FROM AN NDB TRANSMITTER

Tracking an NDB outbound is similar to tracking inbound to the NDB with a slight twist. Using a plotter and the sectional chart you can determine the magnetic course from the Pamlico NDB to the Billy Mitchell Airport at Cape Hatteras NC is approximately 070°. As you approach the Pamlico NDB the ADF pointer will begin to swing 180° as you cross it. As it does do not chase the pointer but maintain your heading (095° on the DG). As you cross over the Pamlico NDB the bearing pointer will be pointing to the rear of the aircraft (because the NDB is now behind you).

Without delay turn the aircraft to the new heading of 070° and then turn the ADF HDG knob to match this new heading (070°) and see if the bearing pointer is pointing exactly at 250° (which is exactly 180° from 070°) on the ADF compass rose? It probably won't as you turned late, after crossing the NDB. The DG and ADF gauges might look similar (or close) to figure 191.

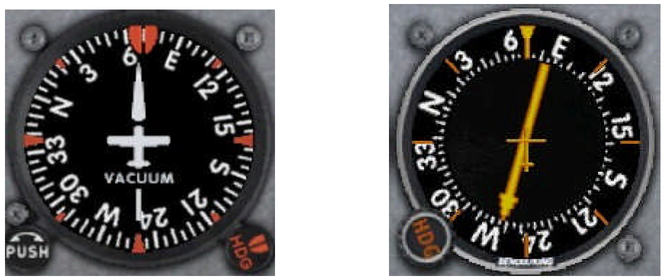


Figure 191 – After turning to the outbound plotted course heading (070 degrees).

To get back on the intended course while outbound from the NDB you must calculate the heading required for the correction. To do this look at the following ADF gauge.

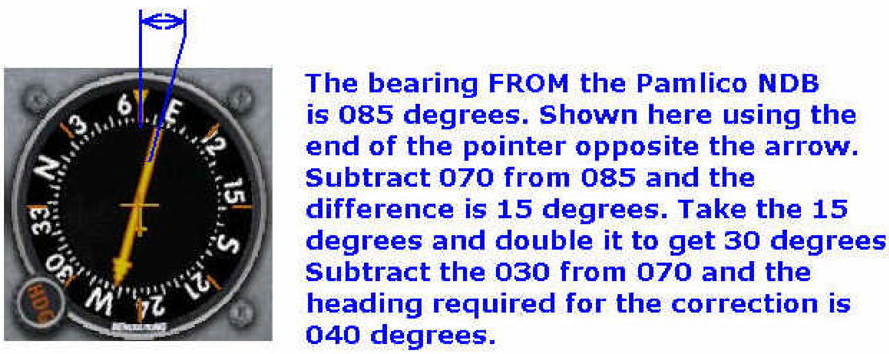


Figure 192 - Calculating a corrective bearing from the NDB.

Working with the opposite end of the pointer (the end opposite the arrow) take the plotted course bearing of 070° and subtract it from the current bearing FROM the NDB shown on the ADF gauge (in this case 085°) to get 15°. As a rule-of-thumb I add 15° more to this calculation to get a total of 30°. Then subtract the 30° from 070° to get 40°. This is the heading to turn the aircraft to and start back toward the plotted course. The gauges should look like figure 193 after turning the aircraft to the corrective heading.

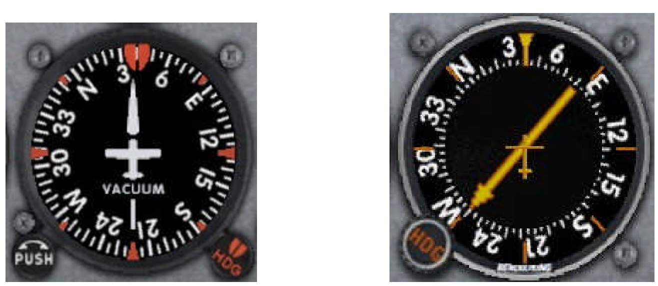


Figure 193 - DG showing the corrective heading with the same set into the ADF gauge.

On the ADF gauge in figure 193 the end of the pointer opposite the arrow is pointing to approximately 081° after turning to the heading calculated for the correction (040°). At this point the ADF pointer will start to swing CCW. The end opposite the arrow will slowly move back to 070° (the end with the arrow pointing behind the aircraft will eventually point at 250°) as seen in figure 194.

Figure 194 - Reaching the proper plotted course of 070°.

At this time turn the aircraft back to 070° and everything should be aligned indicating the aircraft is back on the plotted course. The gauges will look similar to the following.

Figure 195 - Properly aligned on the plotted course of 070° tracking outbound FROM the NDB.

Now let's make another example and say the ADF pointer was pointing to 235° back around figure 191) then this would have indicated the aircraft was turned to soon (or just before reaching the Pamlico NDB), causing the aircraft to be left of the plotted course. In that case the calculation for the correction would be reversed. The end of the pointer opposite the arrow might be pointing toward a bearing of 055°. Calculate the difference in the bearings by subtracting 055° from 070° to again get 15°. Using the rule-of-thumb double this to get 30° and then add the 30° to 070° to get 100° which is the heading required in this case for the correction.

With the aircraft headed 100° and approaching the plotted course the pointer will spin CW in this case toward 070°. Eventually the end of the pointer opposite the arrow will reach 070° (the end with the arrow will reach 250°) at which point the aircraft should be turned back to the 070° heading. If all has worked well the DG and ADF gauges should again match properly as shown in figure 195.

Do not forget that just like tracking inbound to the NDB you must compensate for wind drift (wind direction and speed). You'll need to keep the aircraft turned into the wind depending on the angle of the wind as related to the plotted course and the wind speed. Watch for any drift closely and apply the required correction to keep the aircraft on the plotted course headed in a straight line.

I will emphasize here that NDBs are still very much in use today to provide navigational bearings because they are not as costly as VOR transmitters and simple to maintain. They can also provide a simple means to perform a non-precision approach for landing during IFR conditions. I discuss using the NDB NAVAID for non-precision approaches later in the manual.

NAVIGATION BY GPS

Going back in time celestial navigation (navigation by the stars) was common place and is still used today as a backup means to find one's position on the surface of the earth using a sextant and complex tables. At sea where no other visual references were available mariners learned to use the stars and sun to plot their position. Using that in combination with a magnetic compass they would guide their ships to the intended destination.

Today we can use more technically advanced systems to provide a wealth of information at the touch of our fingers. The Global Positioning System (GPS) is one such system, a non-land based system. It can be used by anyone that has even a small receiver capable of picking up the transmissions of the space borne satellites. If you think of the satellites as a replacement for the stars then you would not be wrong but in this case it is much simpler to use and provides even more information.

When using the GPS system, navigational guidance is provided by a network of satellites in orbit about the planet that triangulate to any given receiver calculating the receiver's position by coded data that the receiver picks up from the satellites via the receivers computer. The really nice thing about a GPS is it can tell the user not only where they are but it can tell the user where any other point on the planet is and guide the user to that point.

GPS units are becoming quite common place in cars, ships, and aircraft. Even hikers in mountainous areas can benefit from the GPS system by carrying a small hand-held unit to tell them where they started from, their current position, and guide them to where they are going. Once you learn to use these devices it is hard to go back and use other systems due to the simplicity and accuracy provided.

This section about the Garmin GPS 500 takes information from the Learning Center within flight simulator. I added an abundance of illustrations beyond that provided in the Learning Center to help you visualize the information or concepts presented. This and other information I provide will give you great insight on the use of the GPS 500.

THE FLIGHT SIMULATOR GARMIN GPS 500

The GPS unit available in flight simulator is the Garmin GPS 500. Another personal favorite I use is the RealityXP Flight Line 530XP (found at http://www.reality-xp.com/) which simulates the Garmin GNS 530 to a tee. In this section I'll demonstrate the default GPS 500 which everyone will have. One of the advantages of navigation by GPS is the ability to fly direct routes between point A and B and have an abundance of information available at your fingertips via the stored data in the GPS computer. Flying direct will use less fuel and save time en route. There are disadvantages also such as not having an airway infrastructure built around the use of GPS guidance. As previously mentioned the current airway structure is built around land-based VOR transmitter technology, so much of the information collected, updated, and printed for use in current maps and charts for use by pilots along the current airways is done using VOR technology. If the pilot flies "off airways" using direct GPS guidance then the information available on these maps and charts becomes less useful than the pilot who flies on the airways. Still, flying on airways using a GPS is not impossible as airway routes can be preloaded and the GPS used to guide the aircraft along these airways.

There are two GPS units in flight simulator, the panel mounted model (the GPS 500) and a portable model (the GPSMAP 295). I'll use the GPS 500 to explain the basics; the GPSMAP 295 has similar pages but the buttons may differ slightly compared to the GPS 500 (for more information about the GPSMAP 295 see the Learning Center inside flight simulator). After learning how to move about in the GPS 500 and what information the various pages provide I'll take you on a demonstration flight to practice using the things learned.

Figure 196 - The Garmin GPS 500.

DISPLAYING THE GPS

The GPS 500 can be displayed in the cockpit by clicking on the GPS icon which looks like this:

Figure 197 - The GPS panel icon.

I used the default Cessna 182 Skylane for testing the procedures and to obtain screenshots for this section. The GPS can also be displayed by pressing SHIFT + 3 or by selecting VIEWS from the pull down menu, then INSTRUMENT PANEL and then GPS.

You can move the GPS anywhere on the screen by the typical "click and drag". If you right-click on the GPS with the mouse you can "undock" the GPS (which effectively turns it into a separate window) and move it to a second monitor if you like out of the way. This is useful but it can be a performance factor for your computer.

OPERATION OF THE GPS KNOBS AND BUTTONS

If the flight simulator options are set properly then you can get a description of various cockpit devices called "Cockpit ToolTips" by pointing at them with the mouse cursor. This includes the buttons and knobs on the GPS.

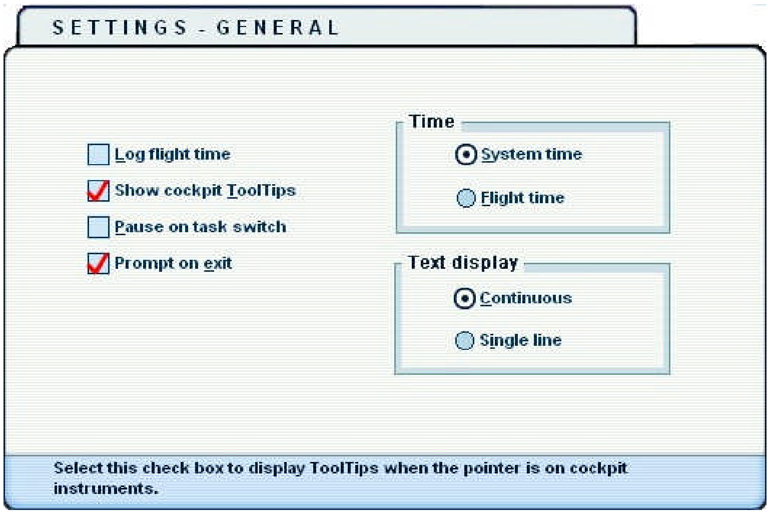


Figure 198 - FS9 general settings.

Make sure the “Show cockpit ToolTips” is checked to display any ToolTips available when the mouse pointer is on buttons, knobs, or instruments.

Clicking (simulating a button press) on any button will cause that button to perform the task assigned to it.

The GPS 500 *small* and *large knobs* help the pilot select various things by “turning” the knobs. This is done one of two ways. Either the pilot can click on the “hotspots” (where the arrows are shown in figure 4) or, if using a mouse with a mouse wheel, when the cursor is placed over a knob (again where the arrows are located) and the cursor changes to a hand the mouse “wheel” can be rolled to “turn” the knob in either direction.

Figure 199 - The GPS 500 small and large knobs.

Also note that when the cursor changes to a hand it will display a plus (+) or a minus (-) to tell the pilot which way the knob will turn if left clicked. The plus (+) will turn the knob to the right and the minus (-) will turn the knob to the left.

INFORMATION PROVIDED BY THE GPS

The GPS 500 in flight simulator can help you determine different types of information for use in flight. Let’s list some of the things it can do for you.

1. It can determine where you are.
2. It can determine where your destination is.
3. It can plot a course from your departure point to the destination.
4. Provide information about airports, VORs, NDBs, and intersections.
5. Locate quickly the nearest airport, VOR, NDB, or airspace.
6. Plot a direct course to any airport, VOR, NDB, or intersection.
7. Provide instrument procedures.
8. Show information about airspace boundaries in your local vicinity.
9. Provide a view of the terrain.
10. Follow a VFR or IFR flight plan.

GPS PAGE GROUPS AND PAGES

Information is displayed on the GPS screen as a page. Only one page can be displayed at a time. There are many pages that can be displayed and related pages are grouped together and are called *page groups*. There are *three* page groups in the GPS 500.

1. The **Navigation page group** which contains two pages, the *Default NAV page* and the *Map page*.
2. The **Waypoint page group** which includes 7 pages, *Airport Location, Airport Runway, Airport Frequency, Airport Approach, Intersection, NDBs*, and *VOR pages*.
3. The **Nearest page group** which includes 5 pages, *Nearest Airport, Nearest Intersection, Nearest NDB, Nearest VOR*, and *Nearest Airspace pages*.

There are also two stand-alone pages, one for the *Active Flight Plan*, and one for *Procedures*.

Getting around within these pages is not as difficult as it may seem. Actually once you learn how it is done it becomes quite simple. Just remember that the large knob (and/or an appropriate button that will be described) gets you to various page groups. Once in the selected group the small knob gets you to the different pages. In other words the large knob will get you to the different chapters in the book and the small knob will flip through the pages within the chapter.

GPS DIRECT ACCESS BUTTONS

Remember these special buttons on the GPS 500 as they provide direct access to their pages.

1. The NRST button on the bottom of the GPS will send you directly to the *Nearest page group*.
2. The FPL button will send you directly to the *Active Flight Plan page*.
3. The PROC button will send you directly to the *Procedures page*.

WHAT GPS PAGE IS THIS?

Once you are in a page group you need to know what page you are on. Take a look at figure 200 which shows the user is in the Navigation page group and is on the first page (that will be the *Default NAV page* as would be seen on this GPS display if shown in it's entirety).

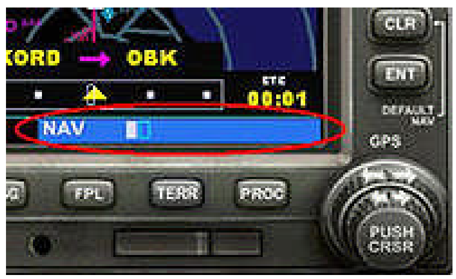


Figure 200 - Pages in a group.

Note that when changing from one page *group* to another page *group* the display *will always return to the last page used within that group*.

GPS DISPLAY SCROLL BARS

If the displayed page has more information than can be displayed on the screen then a scroll bar may appear as seen in figure 201.

Figure 201 - Scroll bar shown on the right side of the display.

To scroll through the display the user must click on the CRSR button (located on the small knob) then rotate the large knob to scroll the screen display.

GPS KNOBS/BUTTONS REVIEW

Figure 202 - The GPS 500 buttons.

1. The **Range (RNG) button** allows the user to zoom the display in and out. The up arrow will zoom out and the down arrow will zoom in.
2. The **Direct-To (D) button** allows you to enter a destination waypoint and will plot a direct course from the aircrafts current position to that waypoint.
3. The **Menu (MENU) button** is used to activate a specific leg in an active flight plan.
4. The **Clear (CLR) button** is used to erase information or cancel an entry. If the user presses and holds this button the display will return to the default NAV page regardless of the page currently displayed.
5. The **Enter (ENT) button** is used to approve an operation or to complete data entry.
6. The **Large Knob** is used to select between the various page groups: NAV, WPT, FPL, or NRST. With the on-screen cursor enabled, the large knob allows you to move the cursor about the page.
7. The **Small Knob** is used to select between the various pages within one of the groups listed above.
8. The **Cursor (CRSR) button** displays the on-screen cursor. The cursor allows the user to enter data and/or make a selection from a list of options.
9. The **Nearest (NRST) button** displays the nearest airports page. Rotating the small knob steps through the other NRST pages.
10. The **OBS (Omnibearing Selector) button** is used to select manual or automatic sequencing of waypoints. Pressing this button selects OBS mode, which will retain the current waypoint you're tracking TO as your navigation reference even after passing the waypoint (in other words it prevents sequencing to the next waypoint). Pressing the OBS button again will return to normal operation, with automatic sequencing of waypoints.
11. The **Message (MSG) button** is used to view airspace alerts.
12. The **Flight Plan (FPL) button** allows you to see and follow a flight plan you have created using the flight planner (within flight simulator) and to access instrument approaches.
13. The **Terrain (TERR) button** allows you to add a graphical depiction of the terrain to the D*efault NAV page* and to the *Map page*.
14. The **Procedures (PROC) button** allows you to add instrument approaches to your flight plan. When using a flight plan, available procedures for your arrival airport are offered automatically. Otherwise, you may select the desired airport, then the desired procedure.

THE NAV/GPS SWITCH

Flight simulator aircraft that use the GPS 500 have a NAV/GPS switch on the instrument panel. When the switch is in the NAV position the aircraft's VOR1/HSI indicator and autopilot/flight director use data from the NAV1 receiver, but when the switch is in the GPS position the aircraft's VOR1/HSI indicator and autopilot/flight director use data from the GPS receiver.

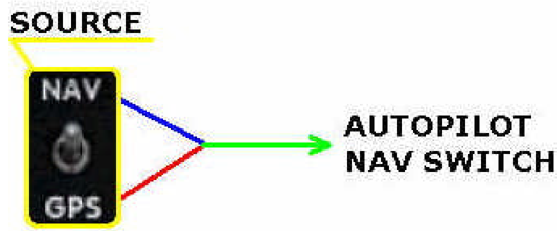


Figure 203 - NAV/GPS switch selects the source data fed to the autopilot/flight director.

Note that the GPS only provides lateral (path) guidance to the autopilot/flight director and the VOR1/HSI indicator. When the VOR1 gauge is receiving data from the GPS the OBS knob will not affect the deflection of the VOR1 CDI as it does when receiving a signal from the NAV1 receiver. The CDI on the VOR1 gauge will always show (match) the CDI on the Default NAV page of the GPS. The GPS can not fly an ILS or land automatically using the GPS as the sole source of navigational data.

Again, remember, *The NAV/GPS switch determines the navigational source fed to the autopilot/flight director and the VOR1/HSI gauges, selecting either the NAV1 receiver or the GPS.*

Okay, now that we have reviewed what the controls do and know a little bit better how to reach the different page groups and pages within those groups lets talk about the different pages. We'll take them in order starting with the Default NAV page which is the first page displayed when the GPS is displayed.

GPS NAVIGATION (NAV) PAGE GROUP

Default NAV Page (Page 1) – The Default NAV page provides a look-ahead map display indicating your current position. Additionally at the top of the page the Ground Track (TRK) is indicated (which is the current flight path over the ground), it is *not* your aircraft heading. Note that *a GPS receiver cannot determine an aircraft's heading* but *only its track across the ground*. Never assume that the TRK (Ground Track) on the GPS display is the same as your heading. *The ground track is influenced by the prevailing winds (any crosswind)*. Also at the bottom of the page your Ground Speed (GS) is indicated. *This speed will be different then the indicated airspeed* (the speed shown on the cockpit airspeed indicator) depending again on the prevailing winds.

Figure 204 - The Default NAV Page (NAV Group Page 1).

If an active flight plan is loaded or you have selected a direct-to waypoint in the GPS the Desired Track (DTK), Ground Track (TRK), and Distance to Destination Waypoint (DIS) will be displayed at the top of the page. The bottom of the page will display the Ground Speed (GS), active TO/FROM waypoints (or the direct-to waypoint), and the Estimated Time En Route (ETE).

There are additional data fields along the left side of the page that display the next waypoint (WPT), the bearing to the next waypoint (BRG), the course to steer (CTS), the estimated time of arrival at the destination waypoint (ETA), the vertical speed required (VSR) to reach the altitude of the next waypoint or the destination runway, the track angle error (TKE), and the crosstrack error (XTK).

A FEW WORDS ABOUT THE GPS COURSE DEVIATION INDICATOR (CDI)
A graphic Course Deviation Indicator (CDI) cursor (which acts much like that of the VOR CDI needle) also appears at the bottom of the Default NAV page.

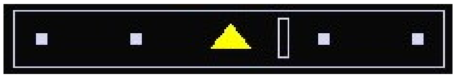


Figure 205 - GPS Course Deviation Indicator (CDI).

Unlike the VOR1 CDI which is mechanical in operation, full scale limits for the GPS CDI are defined by an electronic GPS-derived distance (5.0, 1.0, or 0.3 nautical miles). By default the CDI scale will automatically adjust to the desired limits based upon the current phase of flight such as en route (5.0nm), terminal (1.0nm), or approach (0.3nm). When the CDI cursor deviates from center (either left or right of the yellow arrow) the pilot turns toward the cursor to get back on the proper course line. The cursor should always remain on top of the yellow arrow indicating the aircraft is on the plotted course.

The information I'll discuss here is important (if I had to run my finger nails across a chalk board to get your attention than imagine that is what I'm doing!). There is much more to this than meets the eye.

As mentioned there are three modes of GPS CDI operation, en route, terminal, and approach. What do these modes represent and what is the difference between these modes? Primarily the modes represent the degree of correction applied to the autopilot by the CDI deflections when tracking a plotted course by using different sensitivities for the CDI scale. Even when the pilot is manually flying the aircraft corrections to CDI deflections will need to be smoothly but quickly applied to keep them from going full scale when the sensitivity is at max.

The CDI is located just below where the active leg waypoints are shown as in figure 204. The scale consists of four dots with a yellow (stationary) arrow in the center. This arrow is the GPS TO/FROM flag (operating in a similar manner to the VOR TO/FROM flag). There is also a rectangular cursor that represents the deviation indicator itself that moves left or right depending on the aircraft location compared to the active leg.

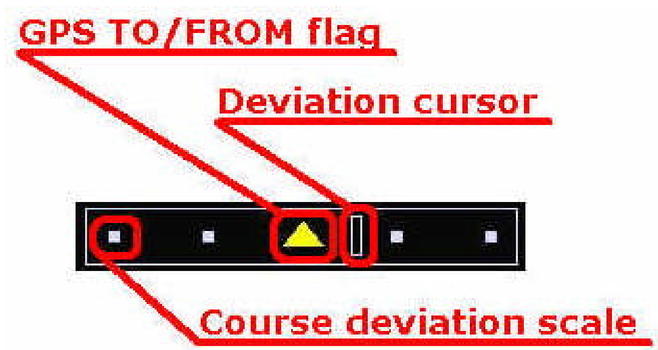


Figure 206 - Parts of the GPS CDI scale.

Typically (there is exceptions to the rule I'll explain shortly) when the aircraft reaches a point near 30nm from the destination the GPS transitions from the en route to the terminal mode and the scale (CDI sensitivity) changes from 5.0nm to 1.0nm full scale deflection. What does this mean? Take a look at figure 207.

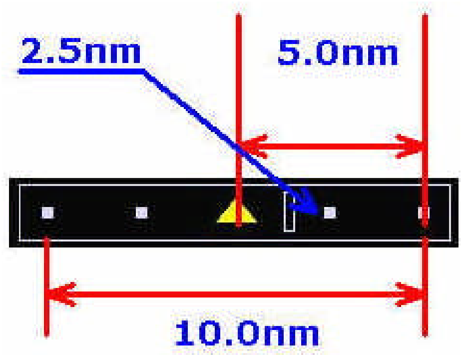


Figure 207 - How the GPS CDI scale is divided.

If the GPS indicates the en route mode is active as seen in figure 204 (bottom left) then the GPS CDI scale operates as shown in figure 207. If the yellow arrow represents the course center line then a full scale deflection is 5.0nm off course. The first dot either left or right is half of the full scale deflection (2.5nm). So the en route mode will display deviations from the plotted course totaling 10nm wide. In figure 207 the CDI cursor is showing the aircraft left of course 1.25 nautical miles. The pilot always turns toward the cursor to get back on course.

If the GPS changes to terminal mode the 5.0nm in figure 207 would represent 1.0nm. The 2.5nm would represent .5nm. The 10.0nm would represent 2nm and the CDI would tell the pilot the aircraft is left of course ¼nm (0.25nm).

The last mode is the approach mode. In the approach mode the 5.0nm in figure 207 would represent 0.3nm. The 2.5nm would represent 0.15nm. The 10.0nm would represent 0.6nm and the CDI would tell the pilot the aircraft is left of course 0.075nm.

So as you can see the CDI display "tightens" into a narrow pathway as it switches from en route (10.0nm wide), to terminal (2.0nm wide), to approach mode (0.6nm wide).

When the GPS is selected as the primary navigational source by switching the NAV/GPS switch to GPS, and used to provide lateral (path) guidance to the autopilot/flight director and the VOR1/HSI gauges, the *VOR1 gauge CDI will mirror the GPS CDI scaling*. It is important for the pilot to recognize this operational trait. Using the CDI needle on the VOR1 gauge for tracking the plotted GPS course is only really useful in the en route mode when coupled to the GPS because the full scale deflection of 5.0nm can easily be sensed by the (mechanical) VOR1 gauge. The more sensitive scaling provided by the GPS in the terminal and approach modes will barely move the VOR1 needle so the pilot must watch the GPS CDI indicator instead when using the GPS to track the plotted course. *I recommend always using the GPS CDI when using the GPS as the primary means for navigation, not the VOR1 gauge CDI.* Again, always remember, when the sensitivity increases (in other words when the pathway tightens) never "chase" the CDI or your aircraft movements will become erratic. Make smooth but timely movements providing a few seconds for the gauge to readjust.

The VOR1 gauge OBS knob will not affect the operation of the CDI needle in the VOR1 gauge when turned (as it does when tracking a signal from the NAV1 receiver) because the CDI needle is locked to the GPS CDI mode. So in such a case spinning the OBS knob is usually only done to keep the gauge bearing set either to the GPS course bearing, or an upcoming bearing for a turn for situational awareness.

The yellow arrow (the GPS TO/FROM flag) will only "flip" to FROM when the aircraft passes the last waypoint loaded in the GPS. This typically only occurs when the flight plan is exhausted (no more waypoints exist) or the automatic sequencing of waypoints is suspended using the OBS button on the GPS. Most likely the only time you will see this happen is if you suspend the waypoint sequencing using the GPS OBS button otherwise the yellow arrow will always be pointed up.

One final but important note about the en route, terminal, and approach modes before moving on, it will be mentioned several times in the examples to follow that the GPS switches from the en route to the terminal mode near 30nm from the destination and again from terminal to approach mode near 10nm from the destination. Well, sort of, there is a catch. *It depends on the waypoints loaded into the GPS and their location in reference to the destination waypoint.* For instance, if the last en route waypoint you have loaded in your flight plan is at a location, say 9nm from the destination waypoint, then you will never see the GPS switch to the terminal mode. It will actually switch straight from the en route mode to the approach mode, skipping the terminal mode altogether. Why? Don't look at me I'm not the programmer <grin>!

Obviously there is a problem either with a coded algorithm calculating the distance of individual legs or in the algorithm used to calculate the switching of modes? If there is only a single waypoint such as a direct-to waypoint loaded into the GPS then the modes switch flawlessly at the 30nm and 10nm points. But if the pilot has a flight plan loaded with several waypoints then I have found the switching of modes does not react as described in the Microsoft Learning Center in the flight simulator.

For instance, if you conduct a flight with the last waypoint (the one before the actual destination waypoint) placed in the flight plan at a location less than 30nm but greater than 10nm from the destination then the GPS will switch from the en route to the terminal mode at that waypoint (not at a point 30 nautical miles from the destination as described) and stay in that mode until reaching a point 10nm from the destination at which time it will switch from terminal to approach mode. If this last waypoint is placed for instance at a 12nm distance from the destination then the GPS wouldn't switch to the terminal mode until reaching this waypoint and would only stay in this mode for another 2 nautical miles before switching into the approach mode at the 10nm point. If as already described I placed the last waypoint less than 10nm from the destination then the GPS would never switch to the terminal mode but go straight to the approach mode.

This anomaly doesn't have any effect on the GPS properly navigating the input route; it only affects how well the tracking is done due to the selected mode (sensitivity). Remember, the CDI sensitivity directly affects the autopilot depending on the sensed deviations from the plotted course. So now that you have this information under your hat let's continue.

The following is a glossary of the abbreviated terms used on the Default NAV page.

1. **BRG (bearing)** – The compass direction from your current position to a destination waypoint.
2. **CTS (course to steer)** – The recommended direction to steer in order to reduce course error or stay on course. The CTS provides the most efficient heading to get back to the desired course and proceed along your intended route.
3. **CUM (cumulative distance)** – The total distance of all legs combined in a flight plan.
4. **DTK (desired track)** – The desired course between the active FROM and TO waypoints.
5. **ETA (estimated time of arrival)** – The estimated time at which you will reach your destination waypoint, based upon current ground speed.

6. **ETE (estimated time en route)** – The time it will take to reach the destination waypoint from your current position, based upon your current ground speed.
7. **GS (ground speed)** – The velocity you are traveling, relative to a ground position.
8. **HDG (heading)** – The direction your aircraft is pointed, based on indications from a magnetic compass or a properly set directional gyro.
9. **TKE (track angle error)** – The angle difference between the desired track and your current track. To reduce the track angle error to zero you must turn left if the number is negative, or right if the number is positive.
10. **TRK (track)** – The direction of movement relative to a ground position. Also referred to as the "Ground Track".
11. **VSR (vertical speed required)** – The vertical speed required to descend/climb from the current position and altitude to reach the altitude of the next waypoint or the destination runway, based upon your current ground speed.
12. **XTK (crosstrack error)** – The distance you are off a desired course in either direction, either left or right. This distance is determined by the current CDI scale mode, en route, terminal, or approach.

Map Page (Page 2) – The second NAV page is the Map page. It displays your current position along with nearby airports, navigation aids, airspace boundaries, lakes, and coastlines. The Map page differs from the Default NAV page by north always being represented at the top of the display (in other words north is always straight up). The Default NAV page always shows the current GPS track pointed straight up regardless of where north is.

Figure 208 - The Map Page (NAV Group Page 2).

THE GPS TERRAIN (TERR) BUTTON

The Default NAV page or the Map page can display terrain to more easily visualize your position relative to the surrounding terrain such as mountain peaks, rivers, lakes, and other major terrain features. To display the terrain on either page click on the Terrain (TERR) button.

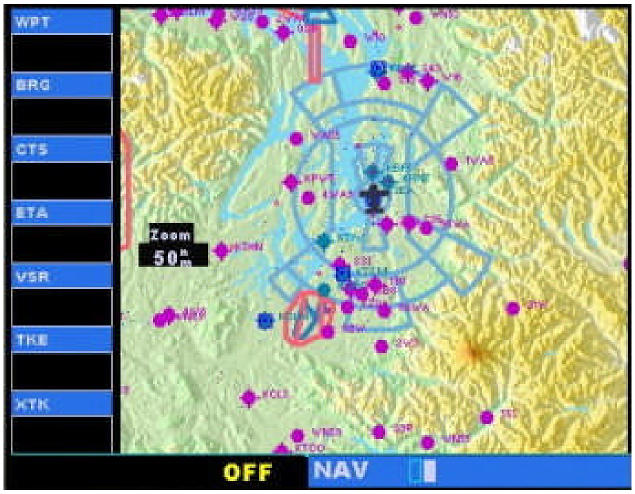


Figure 209 - The TERR button will display the terrain features.

Note that displaying the terrain features in the GPS map can affect the performance of your computer. If your strapped for resources use this feature only when needed.

THE GPS MAP DECLUTTER FEATURE

You can quickly remove displayed elements on the map to effectively "declutter" it by clicking on the CLR button repeatedly (in a cycle). There are 3 levels of declutter to control map detail. The "level" of selected declutter (-1, -2, or -3) are shown next to the zoom mileage on the display.

1. No Class B or C airspace. (-1)
2. No NAVAIDs. (-2)
3. No airports. (-3)

As each declutter level is selected (-1 to -3) the elements indicated are dropped from the display and are not redisplayed until the CLR button is clicked one time after reaching level -3 (effectively deactivating the declutter allowing "all elements" to display again). When declutter is not active -1, -2, or -3 will not show next to the zoom mileage.

THE GPS MAP RANGE (RNG) BUTTON

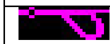
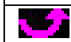
To change the scale of the map use the Range (RNG) button.

Figure 210 - GPS 500 range button.

The scale on the Default NAV page (Look-ahead map) uses one of 20 settings ranging from 500 feet to 500 nautical miles. The scale on the Map page also offers 20 settings ranging from 500 feet to 500 nautical miles. The distance selected is represented from the top of the display to the bottom of the display.

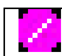
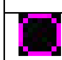
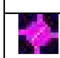
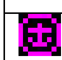
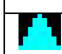
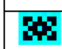
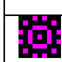
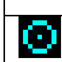
GPS SYMBOLS

The following symbols are displayed directly above the CDI scale arrow on the Default NAV page to depict the active leg of a flight plan or direct-to waypoint.

	Direct-to a waypoint
	Course to a waypoint, or desired course between two waypoints
	Vectors to final
	Left procedure turn
	Right procedure turn
	DME arc to the left
	DME arc to the right
	Left-handed holding pattern
	Right-handed holding pattern

Note that *the GPS receiver will always navigate TO a waypoint unless you set the OBS switch to prevent it from automatically sequencing the waypoints.* The GPS will also stop sequencing when you have passed the last waypoint in your flight. The GPS will automatically sequence to the next leg of a flight plan as you reach each interim waypoint. If you haven't selected a flight plan or direct-to destination this line will remain blank.

The GPS 500 uses the following symbols to depict the various airports and navigation aids on both the Default NAV page and the Map page.

	Airport with a hard-surface runway(s) (Note: Runways shown when zoomed in)
	Airport with soft-surface runway(s) only (Note: Runways shown when zoomed in)
	Airport with fuel
	Seaplane base
	Intersection
	VOR
	VOR/DME
	NDB
	Localizer

GPS WAYPOINT (WPT) PAGE GROUP
The Waypoint (WPT) page group provides information for the thousands of airports, VORs, NDBs, intersections, runways, frequencies, and procedures stored in the flight simulator navigational database.

To enter the waypoint group click and hold the CLR button to select the Default NAV page. Then rotate the large knob to select the WPT page group (WPT will appear in the lower right hand corner of the screen. Then rotate the small knob to select the desired WPT page.

Note that *the on-screen cursor must not be showing to allow using the small knob to select the different pages*. If it is showing click the CRSR button (located on the small knob) to deactivate the cursor on the page.

The WPT page group includes seven pages. The first four pages provide detailed information for the selected airport such as location, runways, frequencies, and approaches. The last three pages provide information for intersections, NDBs, and VORs.

After you select a WPT page you can view information for a waypoint by entering the identifier (or name) of the desired waypoint. To do so click on the CRSR button to display the cursor then rotate the small knob to select the *first character position*. At this point you can use the keyboard to *type in the identifier* of the waypoint (I recommend this method as it saves time).

If you wish you can *continue* rotating the small knob to select a given character. Once the character has been selected rotate the large knob to select the next character position. Again rotate the small knob to select the second character. Repeat using the large and small knobs in this manner until all the characters for the identifier are selected then click the ENT button.

If you select an identifier which has duplicates within the GPS database a duplicate waypoint page will appear as in figure 211.

Figure 211 - Duplicate waypoints page.

All duplicate waypoints will be listed along with their country codes. Use the large knob to scroll through the list.

Airport Location Page (Page 1) – The Airport Location page displays the latitude, longitude, and elevation of the selected airport. The Airport Location page also displays facility name and location, as well as *fuel availability*, and the *best available instrument approach*.

Figure 212 - Airport Location page.

Note that the GPS 500 uses ICAO identifiers for all airports. All United States airport identifiers that contain only letters (except Alaska and Hawaii) use the prefix "K". For example, Atlanta Hartsfield International is KATL under the ICAO standard. Other airports that contain numbers in the identifier, such as Auburn Municipal (S50) do not require the "K" prefix. Alaska, Hawaii and many countries use two letter prefixes and different countries use different prefixes.

Also note that if you encounter difficulty when selecting an airport, try finding the desired airport using the airport name. This will only work on the Airport Location page and not when searching for VORs or NDBs.

Airport Runway Page (Page 2) – The Airport Runway page displays designations, *length*, and *runway surface type* for the selected airport. *Runway surface types can consist of concrete, asphalt, grass, turf, dirt, coral, gravel, oil, steel, bituminous, brick, macadam, planks, sand, shale, tarmac, snow, ice, and water.* The GPS 500 also displays a map image of the runway layout and surrounding area on the Airport Runway page. The map image scale appears in the lower left corner and is adjustable using the RNG button. For airports with multiple runways information for each runway is available.

Figure 213 - The Airport Runway page.

Airport Frequency Page (Page 3) – The Airport Frequency page displays radio frequencies and frequency types for the selected airport. *If the selected airport has a localizer-based approach the page will also list the localizer frequency.* The Airport Frequency page may be used for reference to tune external COM or VOR/ILS frequencies.

Figure 214 - The Airport Frequency page.

You can tune frequencies manually but there is a great feature available here to simplify the task. *If you highlight the facility name in the list of frequencies with the cursor, it will be entered into the standby side of the appropriate radio by simply clicking the ENT button. You must remember to "swap" the frequency on the appropriate radio panel once entered to make it active.*

Airport Approach Page (Page 4) – The Airport Approach page shows the available approach procedures for the selected airport. Where multiple, initial approach fixes (IAFs) and feeder routes are available the GPS may also display that information. A map image provides a layout diagram for each approach and transition.

Figure 215 - The Airport Approach page.

Note that not all approaches in the flight simulator database are approved for GPS use. *As you select an approach a GPS designation to the right of the procedure name indicates the procedure can be flown using the GPS receiver. Some procedures will not have the designation meaning the GPS receiver may be used for supplemental navigation guidance only.* ILS approaches must be flown by tuning the external VOR/ILS receiver to the proper frequency and following the external CDI/HSI for guidance.

Intersection Page (Page 5) – The Intersection page displays the latitude, longitude, and region code for the selected intersection. The Intersection page also displays the identifier, radial, and distance from the nearest VOR or VOR/DME.

Figure 216 - The Intersection page.

Note that the VOR displayed on the Intersection page is the nearest VOR but not necessarily the VOR used to define the intersection. Also intersections may only be selected by identifier.

NDB Page (Page 6) – The NDB page displays the facility name, city, region/country, latitude, and longitude for the selected NDB. *The NDB page also displays the NDB frequency. Note that NDBs may only be selected by identifier.*

Figure 217 - The NDB page.

VOR Page (Page 7) – The last page in the WPT page group is the VOR page. The VOR page displays the facility name, city, region code, magnetic variation, latitude, and longitude for the selected VOR. *The VOR page also displays the VOR frequency.*

Figure 218 - The VOR page.

GPS NEAREST (NRST) PAGE GROUP
The Nearest (NRST) page group provides detailed information for the *nine nearest airports, VORs, NDBs, and intersections within 200 nautical miles of your current position*. The GPS 500 cannot display all nine of the nearest airports, VORs, NDBs, or intersections on the corresponding NRST page at once. The Nearest Airport page for instance will display detailed information for the five nearest airports with a scroll bar to allow viewing the entire list. The NRST pages for VORs, NDBs, intersections, and user waypoints will display nine waypoints at a time. Use the flashing cursor and the large knob to scroll and view the rest of the waypoints or airspaces in the list.

The NRST pages can be used in conjunction with the direct-to function to quickly set a course to a nearby facility. This feature can be a real time saver compared to retrieving information from the database using the WPT pages such as when diverting to an alternate airport. More importantly it will instantly provide navigation information to the nearest airport in case of an in-flight emergency. But remember, *using the direct-to feature will replace the currently loaded flight plan*.

Nearest Airport Page (Page 1) – The Nearest Airport page displays the identifier, symbol, and bearing of the nine nearest airports (within 200nm of your current position) as well as the distance to each airport. For each airport listed, the Nearest Airport page also indicates the bearing to the airport, the distance, the best available approach, the common traffic advisory frequency (CTAF), and the length of the longest runway.

Figure 219 - The Nearest Airport page.

Note that you can also use the Nearest Airport page to quickly find the communications frequencies at a nearby airport for manually tuning the external COM radio. *Additional communications frequencies, runway information, and other details are available from the Nearest Airport page by highlighting the identifier of the desired airport and pressing the ENT button*.

Nearest Intersection Page (Page 2) – The Nearest Intersection page displays the identifier, symbol, and bearing of the nearest intersections (within 200nm of your current position) as well as the distance to each intersection.

Figure 220 - The Nearest Intersection page.

Nearest NDB Page (Page 3) – The Nearest NDB page displays the identifier and symbol of the nine nearest NDBs (within 200nm from your current position) as well as the bearing and distance to each NDB. *For each NDB listed the Nearest NDB page also indicates the frequency of the nearby NDB for reference in tuning the ADF receiver*.

Figure 221 - The Nearest NDB page.

Nearest VOR Page (Page 4) – The Nearest VOR page displays the identifier and symbol of the nine nearest VORs (within 200nm of your current position) as well as the bearing and distance to each VOR. *For each VOR listed the Nearest VOR page also indicates the frequency of the nearby VOR for reference in tuning a VOR receiver*.

Figure 222 - The Nearest VOR page.

Nearest Airspace Page (Page 5) – The last page in the NRST page group is the Nearest Airspace page. This page will alert you to as many as nine controlled or special-use airspaces near or in your flight path. Alerts are provided according to the following conditions:

1. If your projected course will take you inside a controlled or special-use airspace within the next ten minutes the "Airspace ahead – less than 10 minutes" alert will appear. The Nearest Airspace page will show the airspace as "Ahead".
2. If you are within two nautical miles of a controlled or special-use airspace and your current course will take you inside that airspace the message "Airspace near and ahead" will appear. The Nearest Airspace page will show the airspace as "Ahead<2nm".
3. If you are within two nautical miles of a controlled or special-use airspace and your current course will not take you inside the message "Near airspace less than 2nm" will appear. The Nearest Airspace page will show "Within 2nm of airspace".
4. If you have entered a controlled or special-use airspace the message "Inside Airspace" will appear. The Nearest Airspace page will show "Inside of airspace".

Figure 223 - The Nearest Airspace page.

Note that the airspace alerts are based on three-dimensional data (latitude, longitude, and altitude) to avoid nuisance alerts. The alert boundaries for controlled airspace are also divided into sectors to provide complete information on any nearby airspace. Once one of the described conditions exists, the message annunciator above the MSG button will flash alerting you of an airspace message. An altitude buffer of 200 feet is included to provide an extra margin of safety above and below the published limits.

Once you have been provided an airspace alert message, detailed information concerning the specific airspace can be viewed on the Nearest Airspace page. The Nearest Airspace page displays the airspace name, status (Ahead, Ahead<2nm, etc. as described above), and an estimated time to entry (if applicable).

If you are distracted by a near-constant flashing of the message annunciator when flying in an area with lots of controlled airspace then you can temporarily disable the airspace alert messages by clicking and holding the MSG button for at least two seconds which will change the MSG displayed in the message annunciator space above the MSG button to OFF. To turn the messages back on click the message (MSG) button again.

Figure 224 - Message annunciator turned off.

GPS DIRECT-TO (D) WAYPOINT PAGE

The GPS 500's direct-to feature provides a quick method of setting a course to a destination waypoint. Once a direct-to is activated the GPS will establish a point-to-point (great circle) course line from your current position to the selected direct-to destination. Navigation data on the various NAV pages will provide steering guidance until the direct-to is replaced by a new destination.

Figure 225 - The Select Direct-To Waypoint page using an identifier.

Note that if you're navigating to a waypoint using the direct-to and get off course the direct-to feature may also be used to re-center the CDI arrow and proceed to the same waypoint.

Make a special note that if you are navigating an approach with the missed approach point (MAP) as the current destination, re-centering the CDI arrow with the direct-to button will cancel the approach.

In addition to selecting a destination by an identifier the Select Direct-to Waypoint page also allows you to select airports, VORs, and NDBs by facility name. If the database includes duplicate entries for the facility name or city you enter, you can view the additional entries by continuing to rotate the small knob during the selection process.

Figure 226 - The Select Direct-to Waypoint page using a facility name.

Another very useful feature if your navigating using an active flight plan is the ability to select any waypoint contained in the flight plan as a direct-to destination from the Select Direct-to Waypoint page. Again, caution, *this is not the same thing as selecting a specific leg in a flight plan. If you select a waypoint in the flight plan using this method the current flight plan will be replaced with the newly selected waypoint as the destination!*

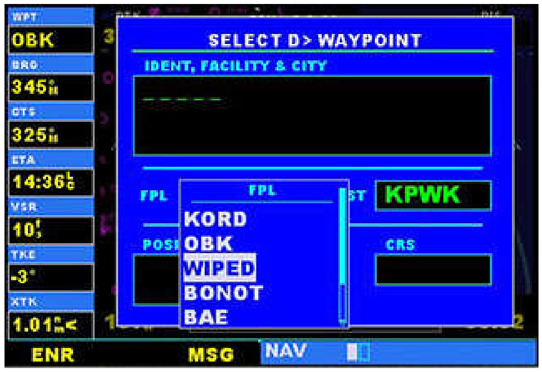


Figure 227 - Selecting a destination from an active flight plan.

The Select Direct-to Waypoint page always displays the nearest airports (to your current position) on the NRST field. Navigating directly to a nearby airport is always just a few simple steps away. Apply the same caution as stated above. *The direct-to feature will replace a loaded flight plan with the selected waypoint!*

Figure 228 – Selecting a nearby airport as a direct-to destination.

Note that shortcuts are available when using the Direct-to button allowing you to bypass the use of the small and large knobs to enter the destination waypoint's identifier. You can perform a direct-to from any page displaying a single waypoint identifier such as the WPT pages for airports and navigation aids by simply clicking on the Direct-to button and then the ENT button twice. For pages that display a list of waypoints such as the Nearest Airport page, you must highlight the desired waypoint with the cursor before pressing the Direct-to button.

GPS ACTIVE FLIGHT PLAN (FPL) PAGE

If you create a VFR or IFR flight plan using the flight simulator flight planner, flight simulator will automatically load the flight plan into the GPS 500 and activate the plan for use in navigation. The Active Flight Plan (FPL) page provides information for the active flight plan (or direct-to waypoint).

Figure 229 - The Active Flight Plan page.

Let me emphasize that *you cannot create flight plans in the GPS 500*. Instead *you must use the flight simulator flight planner or and external flight planner such as FS Navigator*. When you use the flight simulator flight planner the flight plan will automatically be loaded and activated for navigational use. *You can however create a direct-to destination in the GPS 500*. Remember the direct-to feature will only create a course from the present aircraft position to the destination.

With an activated direct-to or flight plan loaded the Active Flight Plan page will show each waypoint for the flight plan (or a single waypoint for a direct-to), along with the desired track (DTK), distance (DIS) for each leg, and cumulative distance (CUM).

You can select any leg within the active flight plan as the active leg (the leg which will currently be used for navigational guidance) using the MENU button. This is very important when you need to sequence ahead to the next waypoint in a flight plan maybe due to controller vectors or some other diversion.

During instrument procedures you can use this feature not only to activate a specific point-to-point leg, but also to activate the procedure turn portion of an approach, follow a DME arc, or activate a holding pattern. You can review any approach on the Airport Approach page in the WPT page group.

GPS PROCEDURES (PROC) PAGE

The GPS 500 will allow you to fly non-precision approaches to airports with published instrument approach procedures. *A non-precision approach is one that lacks an electronic glide slope for the descent to the runway threshold*. Display the Procedures page by clicking the PROC button. The Procedures page provides direct access to approaches based upon the active flight plan or direct-to destination. In either case the destination airport must have published procedures associated with it.

Figure 230 - The Procedures page.

Note that not all approaches in the database are approved for GPS use. *As you select an approach a GPS designation to the right of the procedure name indicates the procedure can be flown using the GPS receiver*. Some procedures will not have this designation, meaning the GPS receiver may be used for supplemental navigation guidance only.

ILS approaches, for example, must be flown by tuning the external VOR/ILS receiver to the proper frequency and using the external CDI/HSI for guidance. In other words you must use the NAV1 receiver and VOR1/HSI gauge.

If you're flying a GPS approach or a non-precision approach approved for GPS use and you plan on using the aircraft's VOR1 indicator to fly the approach make sure the NAV/GPS switch on the aircraft instrument panel is set to GPS. *As previously mentioned I recommend only using the GPS CDI scale when using the GPS as the primary navigation source*. If however you want to fly the approach using data from the NAV1 radio and plan to use the GPS only for situational awareness, then make sure the NAV/GPS switch is set to NAV. Remember, *if you have been navigating to a destination using the GPS and wish to fly an ILS approach for the landing, then at the appropriate time you must switch the NAV/GPS switch to the NAV position. It is a common mistake to forget to flip the switch so the source navigation information provided to the autopilot for an ILS landing is from the NAV1 receiver instead of the GPS*.

Once you select an approach you may activate it for navigation from the Procedures page. Activating the approach overrides (does not replace) the en route portion of the flight plan and causes the aircraft to proceed directly to conduct the approach. If it is a full approach the aircraft will proceed directly to the initial approach fix. Activating the approach also initiates automatic CDI scaling transition as the approach progresses, selecting the appropriate CDI mode (sensitivity).

Figure 231 - Activating an approach on the Procedures page.

It is important to note that another Procedures page option (Vectors-To-Final) allows you to activate the *final course segment* of an approach. This option assumes you will receive vectors to the final approach fix (FAF) and guides you to intercept the final course before reaching the FAF.

In many cases it may be easiest to load the full approach while still some distance away en route to the destination airport. Later, if vectored to final, use the steps above to select "Activate Vectors-To-Final" which makes the inbound course to the FAF waypoint active. Otherwise activate the full approach using the "Activate Approach?" option.

BASIC APPROACH OPERATIONS USING THE GPS

The flight simulator GPS 500 provides primary lateral (path) guidance for non-precision approaches and en route navigation. In other words the GPS can be the navigational source fed to the autopilot for guidance by setting the NAV/GPS source switch to the GPS position and then by activating the NAV mode on the autopilot. The GPS receiver can also be used as a supplemental aid (a means to *monitor* lateral navigation) for precision approaches (ILS) and non-precision localizer-based approaches (such as a localizer or back course approach). In such a case external localizer and glide slope receivers *must* be used for primary approach course guidance. In other words you'll be using the NAV1/2 receivers along with the VOR1 and/or VOR2 gauges as the primary navigation source (if using the autopilot the NAV/GPS switch will be in the NAV position). As a reminder, don't forget that only the NAV1/VOR1 or the GPS can be coupled to the autopilot using the autopilot NAV mode in default aircraft. You can not couple NAV2 to the autopilot in a default aircraft. *So in essence the GPS can be used in two roles, one as the primary source of navigation providing the pilot or autopilot the proper guidance along the plotted course, or as a supplemental source to monitor lateral navigation and the progress along the course flown while using other instrumentation to actually guide the pilot or autopilot (such as the NAV receivers).*

Approaches designed specifically for the GPS are often very simple and don't require over flying a VOR or NDB. GPS approaches have a unique set of waypoints for each approach but currently, many existing non-precision approaches (such as VOR, VOR/DME, NDB, RNAV, and so forth) have GPS overlays to let you fly these procedures more accurately using the GPS rather than using the typical NAVAID prescribed for such an approach.

Many overlay approaches are complex in comparison to GPS-only approaches. The GPS displays and guides you through each leg of the approach, automatically sequencing through each of these legs, including the missed approach procedure. Approaches may be flown "as published" with the full transition, using any published feeder route or initial approach fix (IAF), or may be flown with a vectors-to-final transition (vectors-to-final are provided by a "live" controller).

Remember these points for ALL approaches:

1. The GPS is designed to complement your printed approach plates and vastly improve situational awareness throughout the approach. However, *you must always fly an approach as it appears on the approach chart, especially non-precision approaches where an electronic glide slope is not provided to reach the runway threshold*. I'll teach you about using approach charts (plates) in later chapters about instrument approaches.
2. The active leg (or the portion of the approach currently in use) is depicted in the color magenta on the Map page (reference figure 208). As you fly the approach, the GPS will automatically sequence through each leg of the approach. In other words each leg will change to the color magenta when it becomes active. Legs are white when not active.
3. The published missed approach course is shown as a *dotted white line* extending beyond the missed approach point (MAP). As you pass the MAP, the GPS will sequence to the first missed approach waypoint. At the time the pilot reaches the MAP a decision to land, or fly the published missed approach procedure is required as per the FAR/AIM. Again, I discuss in detail how to conduct instrument approaches including the missed approach in later chapters. Here it is more important to focus on the GPS operations.
4. GPS plotted courses are sometimes not always perfectly straight (reference the magenta colored line in figure 232). Any small deviations in the plotted course (course curves) can cause the autopilot trouble with smooth tracking especially during approaches when the sensitivity of the CDI narrows.

Figure 232 - Slight course deviation in an approach.

In such cases it is wise to either use the heading bug or manually fly the plotted course (instead of using the autopilot) to avoid erratic tracking by the autopilot. The erratic tracking by the autopilot is caused by it "chasing" the plotted course due to the sensitive nature of the CDI while in the approach mode. This may confuse the pilot at a critical moment as to what the autopilot is up to when coupled to the GPS for guidance. This erratic tracking will likely cause an approach to fail due to the timing involved. Always closely review the accuracy of the plotted course on the GPS for any small course deviations compared to an actual approach chart that may upset the approach.

Note that in figure 232 (a representation of the KGSO VOR RWY 5 approach) the course deviation between the FAF (the GSO VOR) and the MAP (the threshold of runway 5) shown on the GPS is incorrect per the actual real-world approach plate seen here in figure 233.

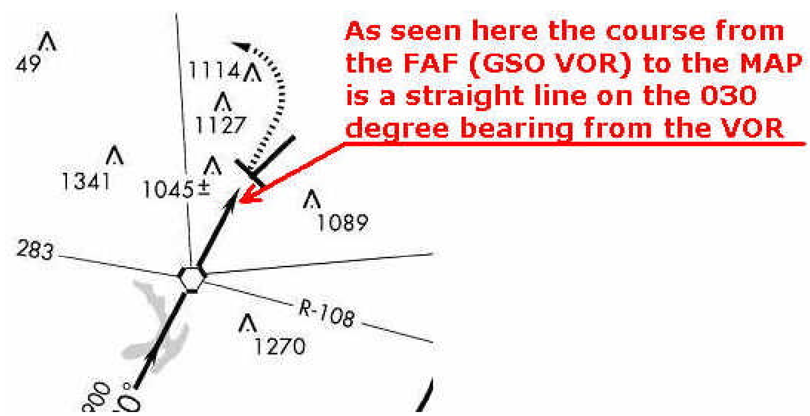


Figure 233 – Partial view of the actual KGSO VOR RWY 5 approach chart.

I will include sections of approach charts (as in figure 233) called approach "plates" by most pilots, or navigation maps to clarify the example GPS operations to follow.

To fly a typical "full" approach using the GPS, follow these steps:

Note that a full approach is an approach that includes a procedure turn or prescribed maneuver(s) to establish the aircraft properly on the approach course.

1. While en route the ATC controller (usually the approach controller) will inform you which approach to expect. Example: *N9COF expect the VOR runway 05 approach.*

2. Click the PROC button and choose the "Select Approach?" option.

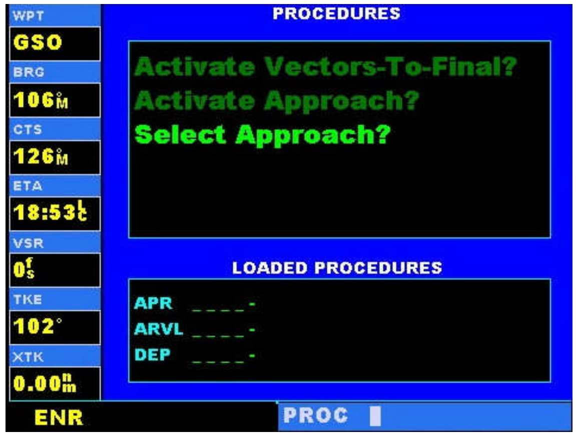


Figure 234 - Select Approach

3. *Load* the expected approach in anticipation of its *future* use (reference figure 235 left). Do not *activate* it just yet, only *load* it. This places the approach in the active flight plan (reference figure 235 right), *but while still retaining course guidance for the en route section until the approach is activated*. Note that the waypoints just below the approach waypoints (circled in red) in figure 235 right are the missed approach waypoints with the holding point listed last. The 1600 feet (MSL) is the initial climb altitude when executing the missed approach (reference the actual approach chart for further information).

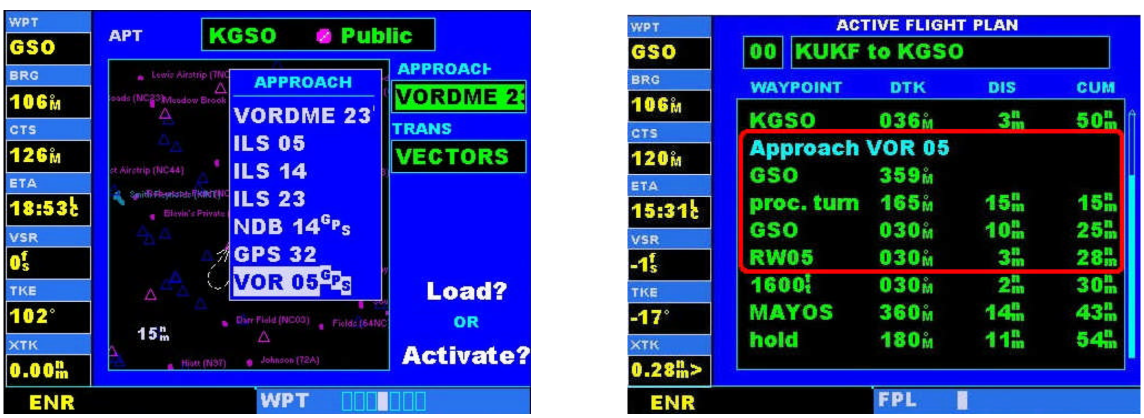


Figure 235 - Loading the selected approach into the flight plan.

4. Later you will *activate the full approach* or *vectors-to-final approach* as appropriate by again clicking on the PROC button which will display the window in figure 236. In some situations you may find it more convenient to immediately *activate* the approach and skip the *load* process (in other words you may not need to stay on the planned route any longer because the ATC controller may have cleared you from your current position to conduct the selected approach). In such a case use the "Activate?" seen in figure 235 left above.

Figure 236 - Activate Vectors-to-Final or the full approach.

The GPS stores the procedure turn portion of an approach as one of the legs of the approach. For this reason the GPS requires no special operations from the pilot other than flying the procedure turn itself (either manually or by autopilot).

To fly procedure turns in an approach follow these steps:

1. Within 30 nautical miles of the destination airport, depending on the flight plan loaded the GPS will switch from en route mode to terminal mode (as indicated in the lower left corner of the screen seen in figure 237 left and right) and the course deviation arrow (CDI) scale will transition from a 5.0 to the 1.0nm full scale deflection.

Figure 237 - En route (ENR) and Terminal (TERM) CDI modes.

2. Several miles prior to reaching the initial approach fix (IAF), in this example it is the GSO VOR, you may wish to review the approach sequence. To do this click on the GPS FPL button to display the Active Flight Plan page (reference figure 238). Then click the CRSR button and rotate the large knob to review each segment of the approach. When finished click on the FPL button again to return to the previous page.

Figure 238 – KGSO VOR RWY 5 approach as listed in the GPS.

Figure 239 is an actual approach plate of the KGSO VOR RWY 5 approach. The chart actually depicts two ways to complete the VOR approach, one using the standard procedure turn and one using DME Arcs. This GPS example uses the standard procedure turn. The aircraft flies inbound to the GSO VOR (the IAF) and upon crossing the VOR the aircraft is turned outbound from the IAF on a heading of 210°. After about 90 seconds the aircraft is turned to a heading of 165° for the procedure turn outbound heading. After another 60 seconds the aircraft is turned 180° to an inbound procedure turn heading of 345° to intercept the GSO VOR 030° radial back to the VOR which is now referenced as the final approach fix (FAF). Note the small **X** on the approach chart which depicts the FAF point. From here the aircraft is kept on the 030° bearing until again crossing the GSO VOR outbound to the missed approach point (MAP) which is near the runway 5 threshold.

The "full" approach is used to orient the pilot to the proper inbound heading for the approach in lieu of controller vectors-to-final. Typically an IFR pilot will receive vectors from a controller but there are situations where a pilot might conduct a full approach such as during a loss of communications or at an uncontrolled airport. You'll learn much more about these situations as you progress through this manual. For now, just be sure to grasp the techniques using the GPS to accomplish these procedures during an approach.

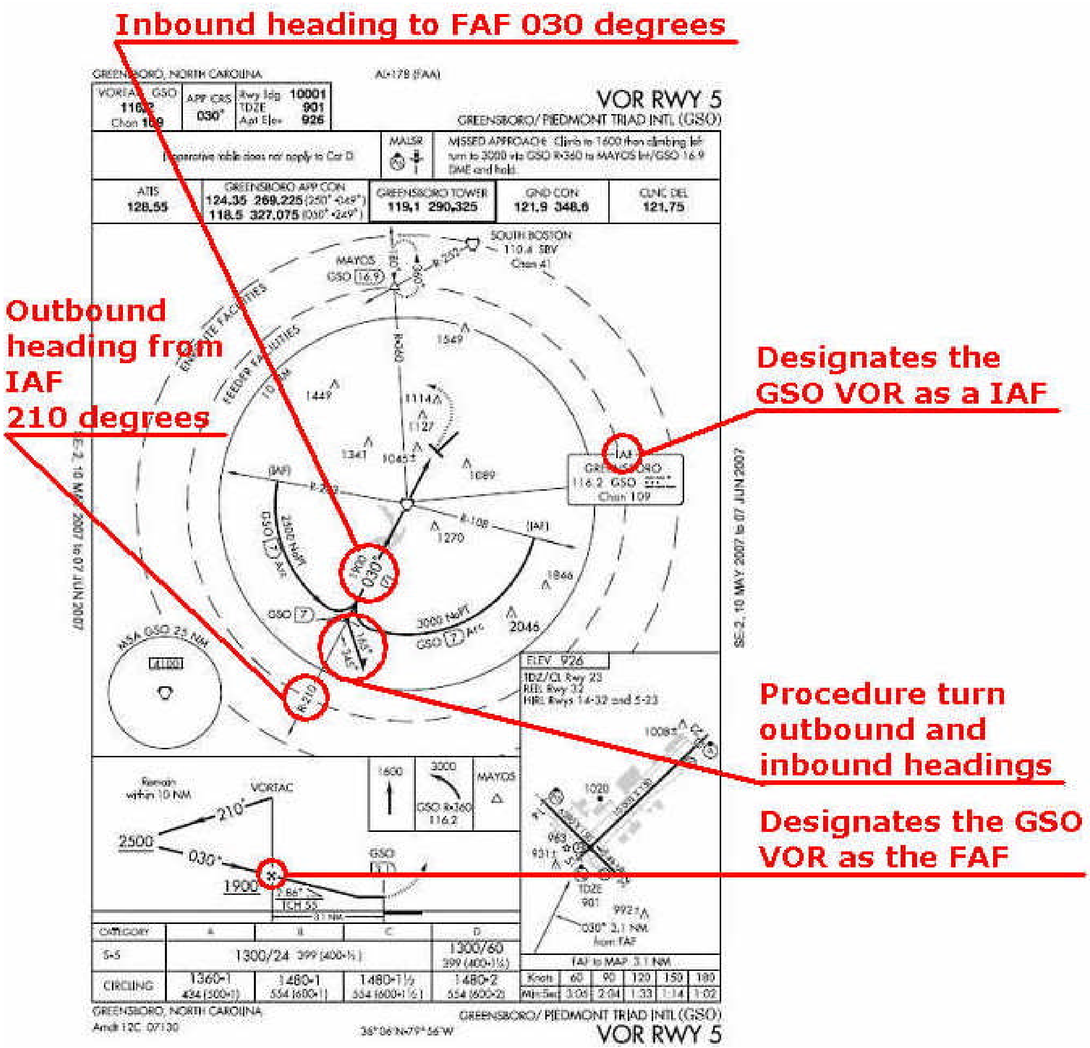


Figure 239 – Actual KGSO VOR RWY 5 Approach Plate.

3. As you approach the IAF, if you are using the GPS as the primary navigational source turn to the outbound heading as indicated on the GPS map if flying the aircraft manually or by the heading bug. If the GPS is coupled to the autopilot then the autopilot will automatically do this for you.

   Or you can use the GPS map to monitor the approach while using the NAV1/VOR1 receiver and gauge for primary navigational guidance. You could also use the NAV2/VOR2 receiver and gauge in this case but you will not be able to couple it to the autopilot, only the NAV1 receiver can be coupled to the autopilot. Reference the section in this chapter about navigation by VORs for more information.

   Again, as previously mentioned the OBS knob will not affect the CDI deflections on the VOR1 gauge when the NAV/GPS source switch is set to the GPS position (the VOR1 gauge is coupled to the GPS CDI scale). I recommend you use the GPS CDI for course deviation indications instead of the VOR1 gauge as the VOR1 gauge does not provide enough indication when the GPS CDI mode changes to either terminal or approach (supposedly the mechanical operation of the VOR1 gauge can not compensate for the different scaling modes sent to it by the GPS CDI which is electronic instead of mechanical). Always fly toward the GPS CDI cursor when it starts to leave the center position to stay on course when using the GPS as the primary navigation device.

Make a special note that the TO/FROM flag on the VOR1 gauge will always mirror that of the yellow arrow depicted on the GPS CDI indicator (reference figure 206). Typically the GPS arrow (the yellow arrow that is stationary in the center of the GPS CDI scale) will always show a TO indication (pointing up). The only time when the GPS arrow shows a FROM indication (pointing down) is when auto sequencing of the GPS is suspended or the aircraft flies beyond the last input waypoint.

4. After approximately 90 seconds (90 seconds is a typical rule-of-thumb depending on the aircraft type) turn 45° degrees left or right (as indicated on the procedure chart or GPS) to start the procedure turn. The outbound leg for this procedure turn is 165°. The GPS receivers will provide course guidance (shown as a magenta colored leg seen partially in figure 240) for the outbound leg from the IAF (the GSO VOR) and through the procedure turn itself.

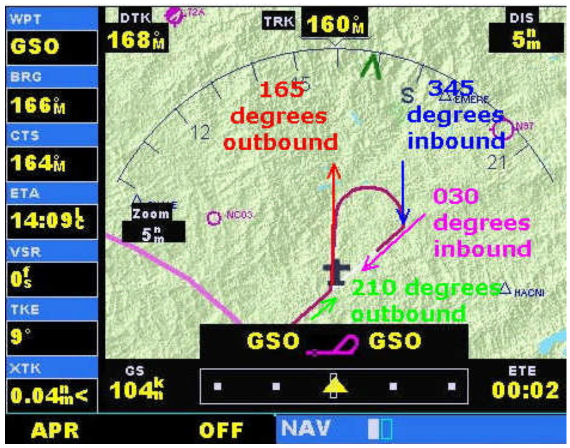


Figure 240 - GPS procedure turn outbound and inbound.

5. After approximately 60 seconds (this is also a rule-of-thumb), make a 180° right turn (or left turn as appropriate) to intercept the inbound course (in this case the 030° line). The inbound leg of the procedure turn is 345° as seen in figure 240. Always remember that the 180° turn is made in the direction opposite from the FAF location (in this case it is a right turn). After completing the procedure turn the GPS will automatically sequence and show the inbound leg to the FAF (the GSO VOR).

Figure 241 – Inbound to the FAF after leaving the procedure turn.

6. As the GPS CDI starts to center finalize the turn to the final approach course (in this case 030°).

7. If within 10nm of the airport (it is normal for procedure turns to be completed within a 10nm radius of the FAF) the GPS will switch from terminal mode to approach mode. The GPS CDI scaling will tightened from 1.0 to 0.3 nautical miles when in approach mode for full scale deflection as previously described.

8. As you approach the FAF (the GSO VOR) make any course adjustments necessary for the final course segment (FAF to MAP).

   Note the difference when the GSO VOR is referenced as the IAF and FAF since it is used as both in this approach. It is referenced as the IAF *before* the procedure turn but *after* the procedure turn it is referenced as the FAF. The distinction/division is made by the procedure turn.

Figure 242 - Approaching the FAF.

9. As you cross the FAF the destination sequences to the MAP (the RW05 waypoint).

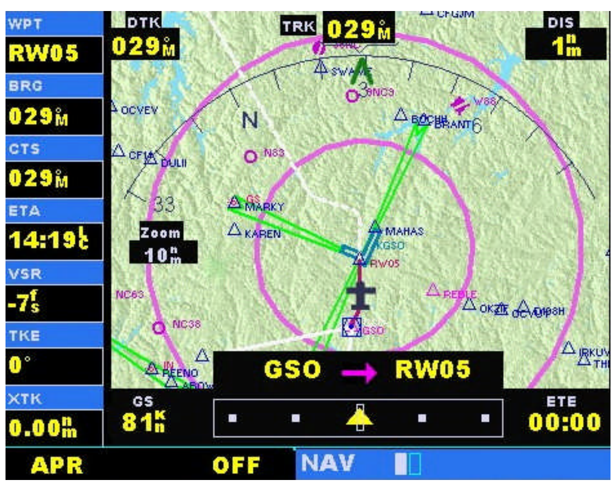


Figure 243 - FAF (GSO VOR) to the MAP (RW05 waypoint).

10. With the needle centered fly toward the MAP observing the altitude minimums indicated by the approach plate. Note that the minimum altitude the pilot can descend to (indicated on the KGSO VOR RWY 5 approach chart) from the FAF to the MAP is 1300 feet until the runway environment can be seen and a safe landing conducted.

Figure 244 - This was the approach view as seen in figure 243 from the cockpit.

11. If the weather were below the minimums and the pilot could not make out the runway environment before reaching the MAP then as the pilot passes the MAP the GPS will sequence to the first missed approach waypoint so the pilot can properly execute the missed approach.

12. The pilot makes the decision to land or fly the published missed approach procedure at the MAP.

To fly missed approaches follow these steps:

1. Follow the missed approach procedures as published on your approach chart for proper climb and heading instructions. The GPS will guide you through the published missed approach procedure to the holding pattern and will provide course guidance through the holding pattern including a modified entry. If coupled to the autopilot the pilot will primarily be concerned about the aircraft altitude. Be sure to meet the missed approach altitude requirements as shown on the approach chart. The initial altitude of 1600 feet is also listed in the GPS missed approach waypoints found when you click on the FPL button (reference figure 238). Be sure to scroll down the list to see all the waypoints.

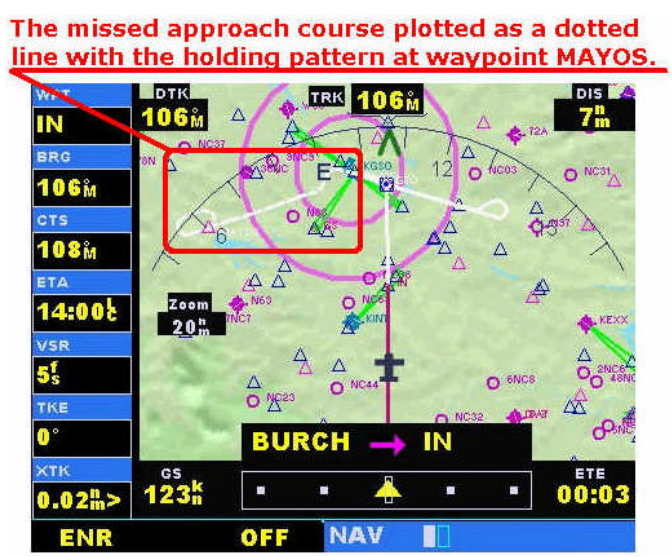


Figure 245 - Flying a missed approach.

Note in figure 245 the slight left turn depicted just as you leave the airport area is identical to the real-world missed approach instructions (reference 239) which read as follows: MISSED APPROACH – Climb to 1600 then climbing left turn to 3000 via GSO R-360 to MAYOS Int/GSO 16.9 DME and hold.

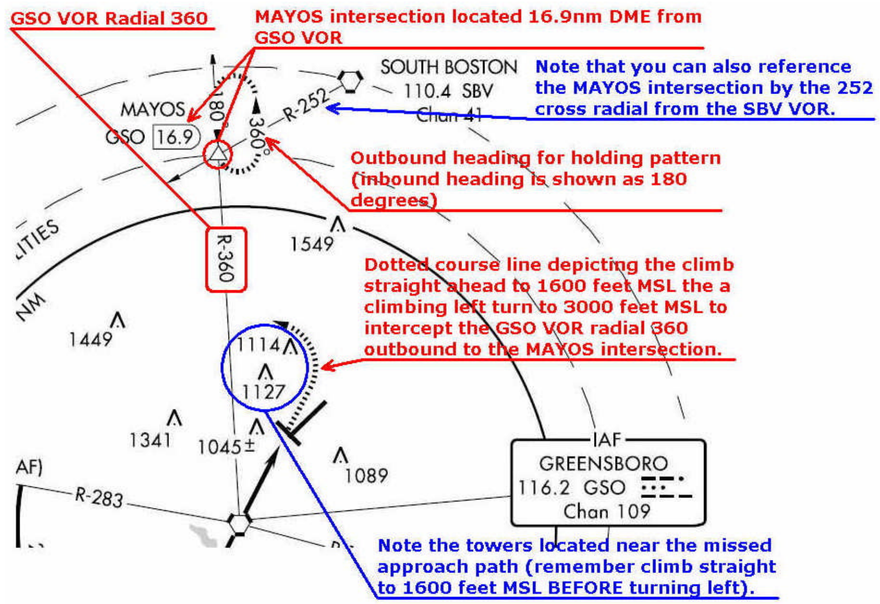


Figure 246 - Actual approach chart view of the missed approach path.

Basically to spell it out, the pilot, after deciding a safe landing can not be made at the time of reaching the MAP flies the runway heading while climbing to 1600 feet, after reaching 1600 feet the pilot makes a left turn while continuing to climb to 3000 feet to intercept the GSO VOR 360° radial outbound to the MAYOS intersection which is located 16.9nm DME from the GSO VOR where the pilot enters a holding pattern until further instructions are received from the controller. Typically the pilot never gets to the holding point because you will tell the controller your intentions. The controller will normally provide vectors to conduct the approach again, or provide vectors to conduct a different approach, or send the pilot on their way to the alternate airport.

The GPS will guide the aircraft along the indicated path BUT *the pilot must ensure the aircraft reaches the indicated altitudes in a timely manner*. The GPS does ***not*** provide vertical guidance such as might be provided by a flight management computer (FMC). *In other words, if the GPS is coupled to the autopilot then the GPS will turn the aircraft to the left along the indicated path of the missed approach with no consideration for the aircraft altitude. So if the pilot fails to climb appropriately after declaring the missed approach at the MAP then there is a strong possibility that ground obstacles could be struck*.

2. When leaving the holding pattern to try the approach again (or even a different approach), click on the PROC button to select a new approach via "Select Approach?" or to activate the same approach again via "Activate Approach?" as previously described. Or you can use the direct-to button to select another destination (such as an alternate airport). *Note that after you use the direct-to button and select an alternate airport your flight plan will be replaced with the direct-to plotted course*. That shouldn't be a problem at this point if you need to get to an alternate because you can't land at the original destination (in this case KGSO). Your original flight plan will be of no further use.

To fly approaches with a hold follow these steps:

1. Within 30nm of the airport the GPS will switch from en route mode to terminal mode and the CDI scale will transition from 5.0 to 1.0 nautical miles full scale deflection.

2. The GPS will display the holding pattern on the Map page and indicate the holding pattern as the active leg on the Default NAV and Active Flight Plan pages.

Figure 247 - Entering an approach with a holding pattern.

Note that this example uses the VOR/DME approach for Aspen CO (KASE). I used the Cessna C208 Caravan to fly this approach due to the higher altitudes (up to 16000 feet).

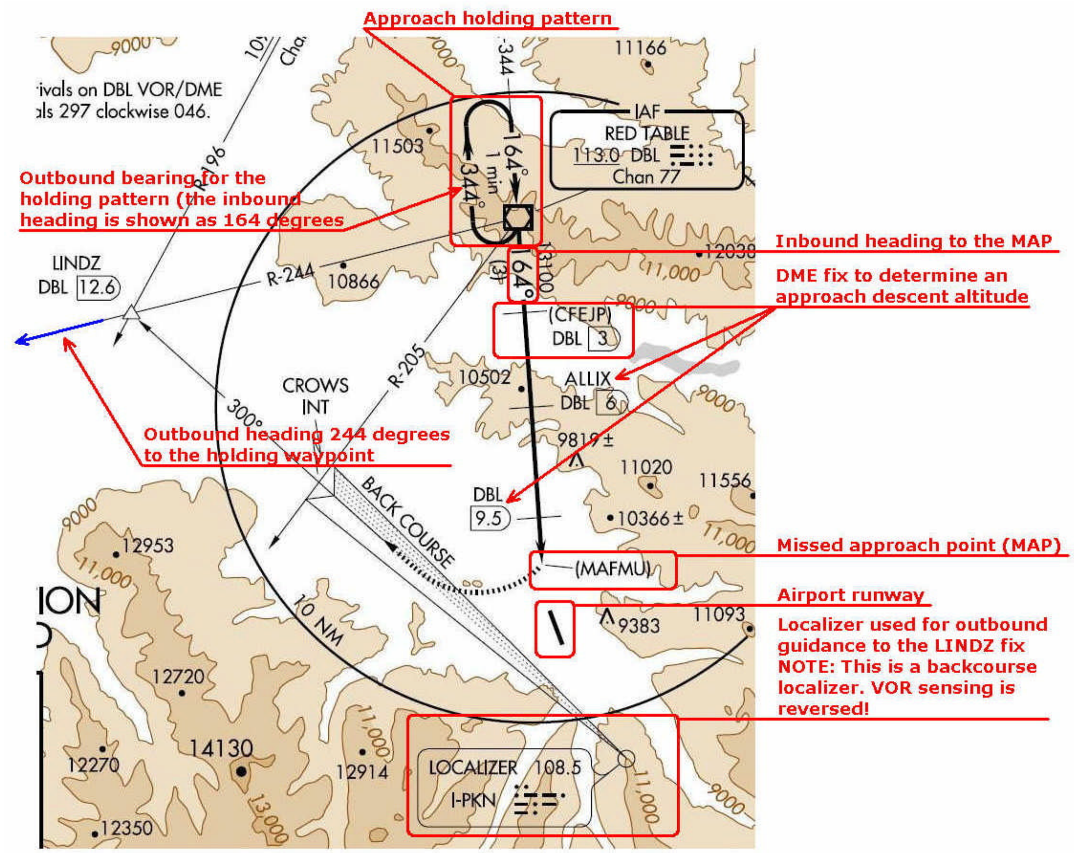


Figure 248 - Partial view of the approach chart for the KASE VOR/DME approach.

3. The GPS will provide course guidance through the holding pattern including a modified entry. Note that if you need to lose extra altitude or speed by going around the holding pattern again press the OBS button to *manually suspend waypoint sequencing before crossing the holding waypoint the second time*.

   If you've already passed this waypoint the second time and need to enter the holding pattern again reactivate the holding pattern on the Active Flight Plan page. To do this click on the FPL button to enter the Active Flight Plan page then click on the small knob where it says push for cursor. Move the mouse cursor over the large knob at the two arrows then turn the mouse wheel (or click the left mouse button) to scroll down the flight plan list. Select the waypoint entry for the holding pattern and then click on the MENU button which will allow you to activate that leg by clicking on the GPS ENT button.

4. Within 10nm of the airport the GPS will switch from terminal mode to approach mode. The CDI scaling will be tightened from 1.0 to 0.3nm full scale deflection.

5. Make any course adjustments necessary for the final course segment (FAF to MAP).

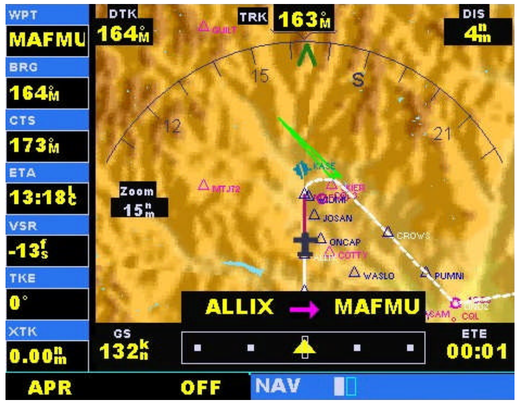


Figure 249 - FAF (ALLIX) to the MAP (MAFMU).

6. As you cross the FAF the GPS will sequence the destination to the MAP. With the CDI centered fly toward the MAP observing the altitude minimums dictated by the approach chart. In this case after passing the DBL DME 9.5 the pilot can descend to the minimum circling altitude of 10200 feet MSL until reaching the MAP.

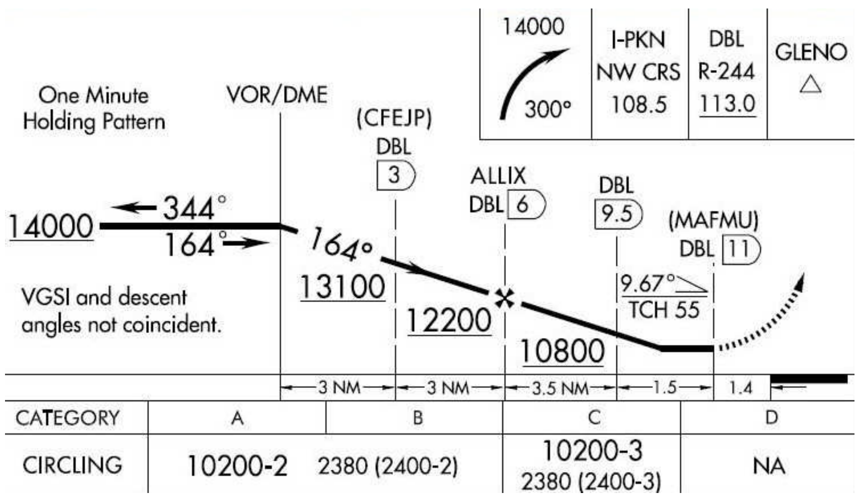


Figure 250 - Minimum altitudes for this approach.

7. As you pass the MAP the GPS will sequence to the first missed approach waypoint. In this case CROWS is the first waypoint in the missed approach (reference figure 251).

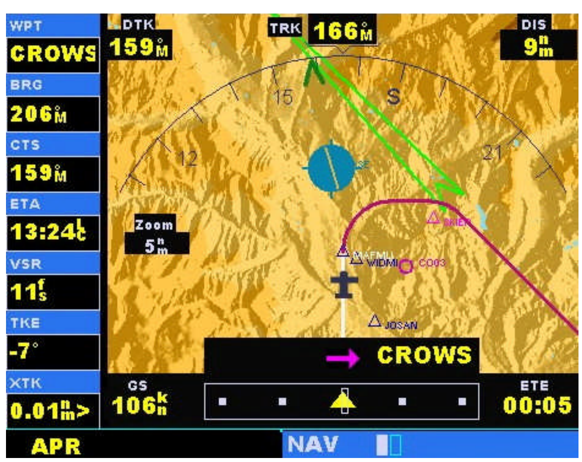


Figure 251 - The first missed approach leg starting at the MAP (MAFMU) and ending at CROWS intersection.

8. Land or fly the published missed approach procedure as appropriate. In this approach the pilot can actually circle to land on the opposite end of the approach runway as long as the airport environment can always be kept in sight.

To fly a DME arc follow these steps:

When the online ATC controller clears you to conduct the DME arc approach you may either follow a specified radial inbound to intercept the IAF or you may follow ATC vectors which allow you to intercept the DME Arc at any point along the arc. In this example I'll use the DME Arc in the KGSO VOR RWY 23 approach and go back to the Cessna 182. Figure 252 is a partial view of the actual approach chart for the DME Arc approach.

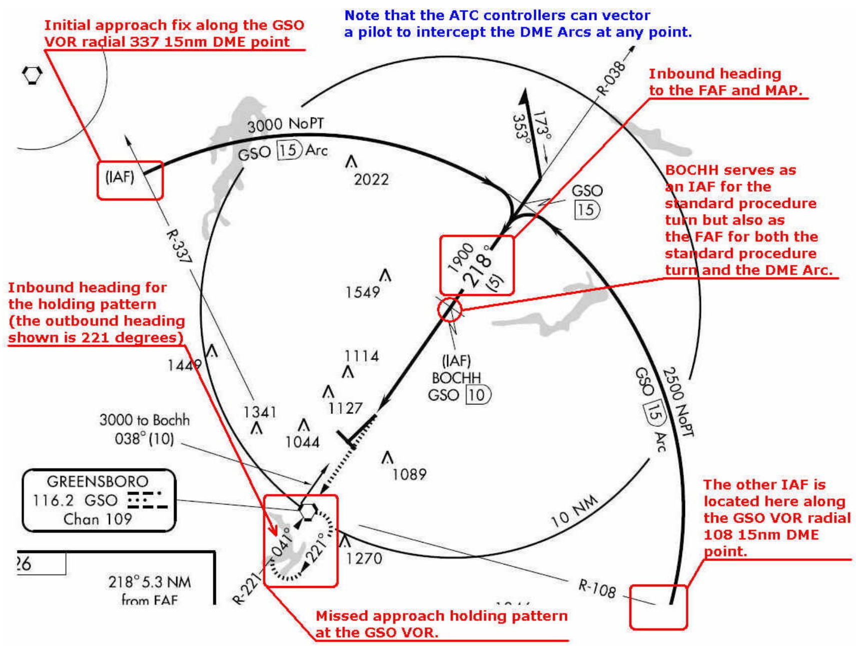


Figure 252 - Partial view of the actual KGSO VOR/DME RWY 23 approach chart.

1. Within 30nm of the destination the GPS will switch from en route mode to terminal mode and the CDI scale will transition from 5.0 to 1.0nm full scale deflection.

2. If you haven't already activated the approach be sure to do so when cleared for the approach or use vectors-to-final if appropriate.

3. If you want to fly the approach using data from the NAV1 radio and use the GPS just for situational awareness then make sure the NAV/GPS switch is set to NAV. I recommend you use the GPS if a GPS approved approach is available. The GPS makes flying a DME Arc a snap.

4. Follow the arc keeping the GPS CDI needle centered.

5. The DME Arc will probably have one or more intermediate fixes. When a fix becomes the active waypoint initiate a standard rate turn toward it.

6. Within 10nm of the airport the GPS will switch from terminal mode to approach mode. CDI scaling will be tightened from 1.0 to 0.3nm full scale deflection.

7. Turn to the final course segment heading (in this case it is 218°).

8. As you cross the FAF (BOCHH) the destination sequences to the MAP (the MAP is the GSO VOR 4.7 DME fix). With the needle centered fly toward the MAP observing the altitude minimums dictated by the approach chart. After passing the FAF the pilot can descend to the minimum straight-in approach altitude of 1300 feet MSL.

9. As you pass the MAP the GPS will sequence to the first missed approach waypoint (in this case the first waypoint is the holding waypoint over the GSO VOR).

10. Land or fly the published missed approach procedure as appropriate.

Figure 253 - Flying the KGSO VOR/DME RWY 23 approach using the DME Arc.

Flying a Vectors-to-Final Approach:

If ATC tells you to “expect vectors” to the final approach course there are several ways to select “vectors-to-final”. The first two options normally require the least effort.

1. When the approach is selected choose “VECTORS” from the transitions (TRANS) window (reference figure 235 left) or...

   Load a full approach including the IAF from the transitions window (also reference figure 235 left).

2. When cleared for the approach click the PROC button and select “Activate Vectors-to-Final?” or…

   Load the full approach by selecting “Activate Approach”.

3. On the Active Flight Plan page highlight the desired leg of the approach then press the MENU button. Then click the ENT button to activate the leg.

Figure 254 - Vectors-to-Final approach as displayed on the map.

The GPS has no way of knowing how ATC will vector you, just that you will intercept the final approach course somewhere outside the FAF (the controller should know this also). Thus with a vectors-to-final approach activated the Map page will display an extension of the final approach course in the color magenta (remember, magenta is used to depict the active leg of the flight plan) and the VTF (vectors-to-final) symbol will appear above the yellow arrow on the CDI scale as part of the active leg reference on the Default NAV page. The CDI needle will remain off center until you're established on the final approach course and then the GPS will sequence to the next leg (FAF to MAP) as you cross the FAF.

Note that during the vectoring phase of a vectors-to-final approach all of the information displayed in the GPS data blocks (DTK, DIS, CTS, and so forth) references the FAF. The GPS doesn't know where you will intercept the final approach course, just that you will eventually reach the FAF.

To fly an approach via ATC vectors follow these steps:

1. Within 30nm of the destination the GPS will switch from en route mode to terminal mode and the CDI scale will transition from 5.0 to 1.0nm full scale deflection.

2. If you haven't already done so, activate the approach with vectors-to-final.

3. ATC will give you multiple vectors.

4. ATC will instruct you to turn to intercept the final approach course. As you converge with the final approach course the CDI needle moves toward the center.

5. As the CDI needle centers make any remaining course corrections to establish the aircraft on the final approach course.

6. Within 10nm of the airport the GPS will switch from terminal mode to approach mode. CDI scaling will be tightened from 1.0 to 0.3nm full scale deflection.

7. As you cross the FAF the destination sequences to the MAP. With the needle centered fly toward the MAP observing the altitude minimums depicted on the approach chart.

8. As you pass the MAP the GPS will sequence to the first missed approach waypoint.

9. Land or fly the published missed approach procedure as appropriate.

Note that if you wish to fly a vectors-to-final approach using the autopilot (instead of flying the approach manually via the old "iron knuckles" method described above) then follow these procedures:

1. Use the Heading (HDG) mode on the autopilot.

2. ATC will vector you to the final approach course and you can follow these vectors by moving the heading bug on the directional gyro (DG).

3. Once you intercept the final approach course you can switch to the Navigation (NAV) or Approach (APR) mode on the autopilot as appropriate. For instance, you would use the autopilot NAV mode to couple the autopilot to the NAV1 receiver or GPS to conduct a non-precision approach. The only time you will use the approach (APR) mode button on the autopilot will be when conducting a precision approach (ILS approach).

BASIC NAVIGATION OPERATIONS USING THE GPS

You might think that the easiest part of using the GPS 500 would be loading a flight plan or selecting a direct-to waypoint but I hope to make you think about this a bit more. You might ask yourself a question like "…is there anything special about a flight plan that one might need to know to better utilize the GPS during online activities?" The answer is yes!

When reading this section you'll think you're getting a lesson in filing flight plans. Well in a way you are but in this case it is tied directly to the use of the GPS 500 and is very appropriate so I saved it for this section. I'm going to show you things to keep in mind when you create a flight plan using the flight planner tool in the flight simulator or any other flight planner tool such as FS Navigator. The concepts you'll learn in this section can be applied to creating any flight plan with any tool. Whether you choose to fly on airways or off airways these concepts/techniques will keep the controllers happy and your experience a good one.

Let me create an example flight plan using the flight simulator flight planner.

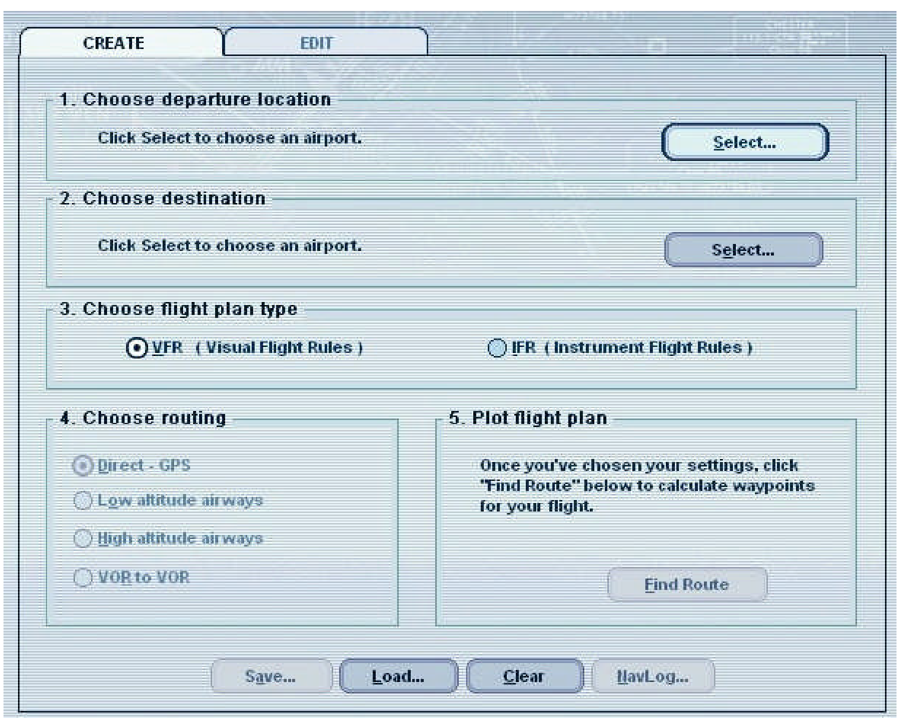


Figure 255 - Default flight planner screen.

Figure 255 shows the default page that appears when you enter the flight planner. There are 5 basic steps to creating a flight plan. When you complete these steps the flight planner will automatically generate a flight plan that we will edit before submitting it to be loaded into the GPS 500 because they can typically always be made better using the concepts to follow.

Every flight starts at a departure airport (location), so click on the top SELECT button to choose the departure location first. A page as shown in figure 256 will pop up.

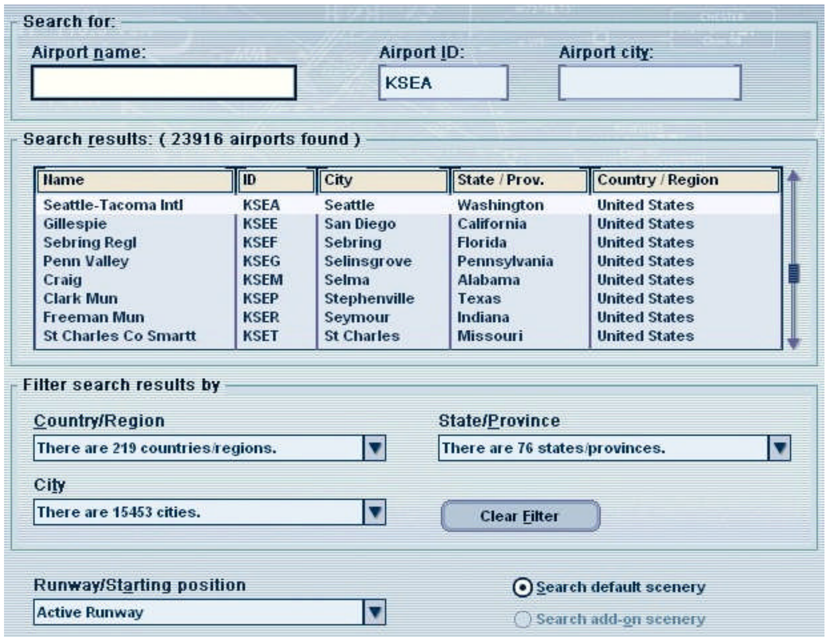


Figure 256 - Airport selection page.

Above the default airport KSEA is listed. We need to find the Raleigh/Durham International Airport. You can use any of the three search criteria blocks for airport name, airport ID, or airport city. If you're experienced with ICAOs identifications (the same as airport ID) then this is the easiest way to go. If you don't know the ICAO identifier then use one of the others. The ICAO identifier for Raleigh/Durham Airport is KRDU, so highlight KSEA and replace it with KRDU. As you type in the letters each successive letter will advance the list in alphabetical order per the characters entered. For instance, when you type in the K the listed search results (reference the ID column because you're using the airport ID search) will go to the first K in the ID column. When you enter the next letter R then the list will advance to the first ID starting with KR. When you enter the D the list will advance to the first ID starting with KRD and finally when you type in the U the list should find the KRDU identifier. If it doesn't then the ID is not in the database or you have an incorrect ID. Try looking for the airport using the airport name or city instead.

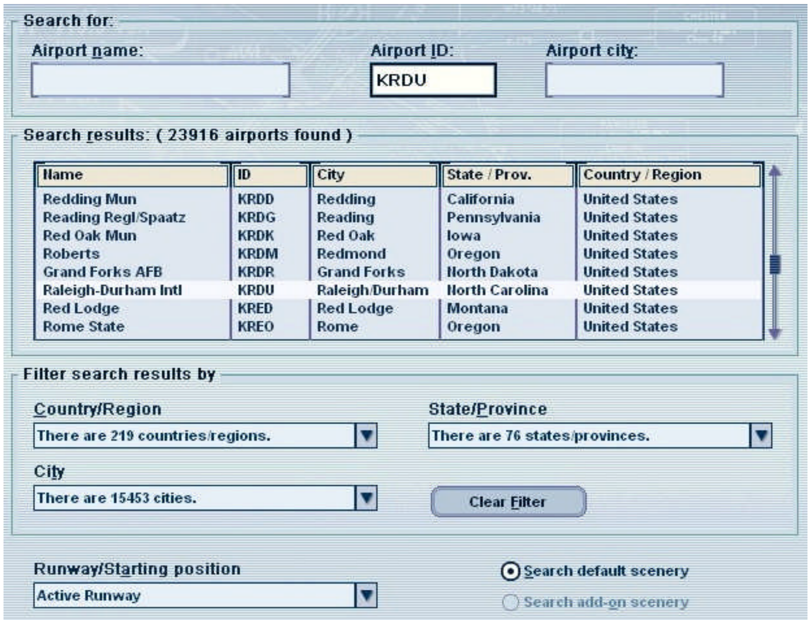


Figure 257 - Finding KRDU in the airport database.

Now place your mouse cursor on the listed airport and make sure it is highlighted. If you don't do this then the runway/starting positions may not show up correctly leaving you with only the active runway to choose from. There will be a fine black line around the listed airport when selected.

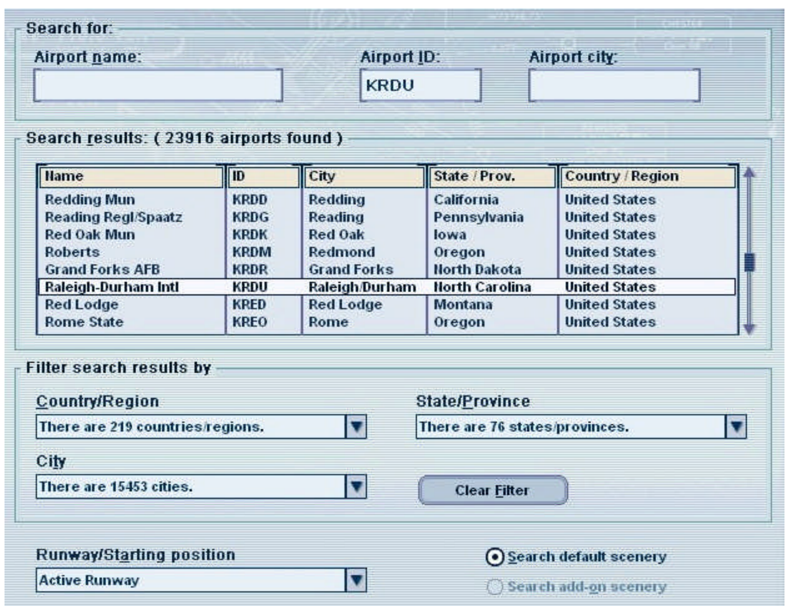


Figure 258 - Make sure to highlight the airport in the list.

When you join an online activity always start from a gate or parking position (when you submit the flight plan the planner will move the aircraft to the selected parking spot). Never choose the active runway as doing so may cause a crash with other aircraft landing or taking off from the runway during a multiplayer activity (typically we leave the crash detection turned off <grin>). Pull down the menu and select a starting position. When done click the OKAY button. When you return to the main flight planner screen go through the same process for selecting the destination airport.

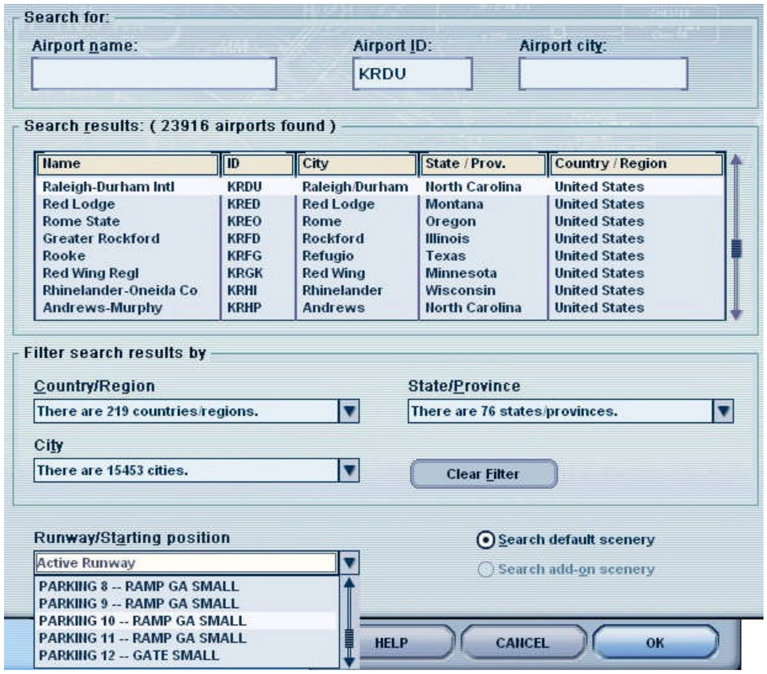


Figure 259 - Selecting a starting point.

Next select the type of flight plan being filed, either VFR (flying by visual flight rules) or IFR (flying by instrument flight rules). In this case choose IFR.

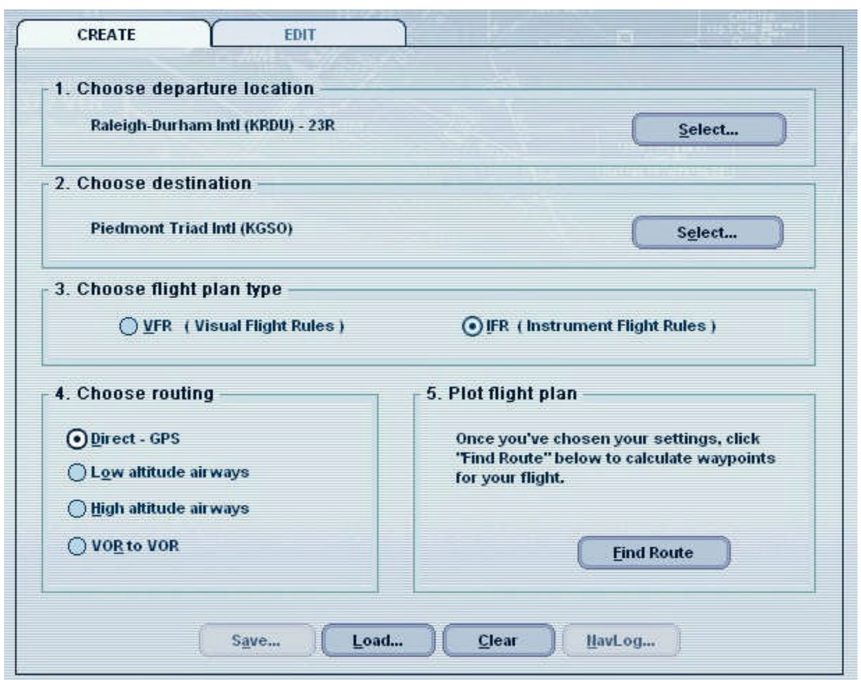


Figure 260 - Select the type of flight plan being filed, either VFR or IFR.

The next step is very important. It will determine how the route is automatically plotted, either direct (basically point A to point B), using low altitude airways (Victor Airways), using high altitude airways (Jet Airways), or VOR-to-VOR.

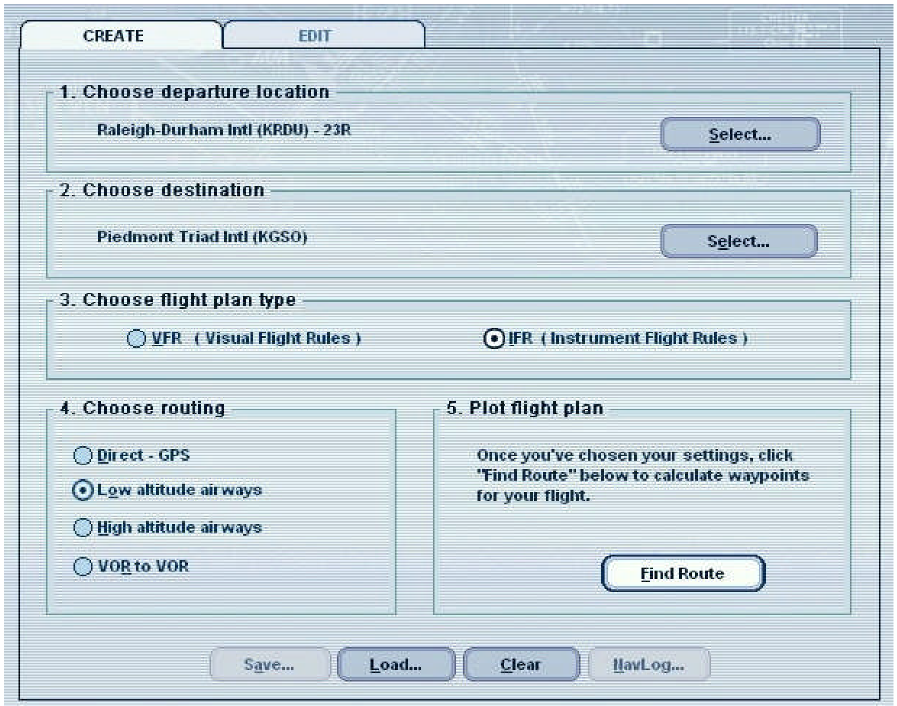


Figure 261 - Selecting the method to plot the route.

The choices are not difficult but let me make some recommendations. If you're not going to fly off airways (by using the direct method) then use either the low or high altitude airways. Use the Victor Airways (low airways) for aircraft that will fly below 18000 feet MSL. Use the Jet Airways (high airways) for aircraft that will fly at or above 18000 feet MSL. I mentioned this during the discussion about airways earlier in this chapter. If you select the VOR-to-VOR method you will most likely end up using some airway route anyway (because the airways are built around the VOR transmitters) so it isn't that useful of a selection. So in our case here I selected the low altitude airways because I'm using the Cessna 182 flying westbound at 6000 feet MSL. Once this selection is made click on the find route button to have the flight planner automatically plot the route as entered.

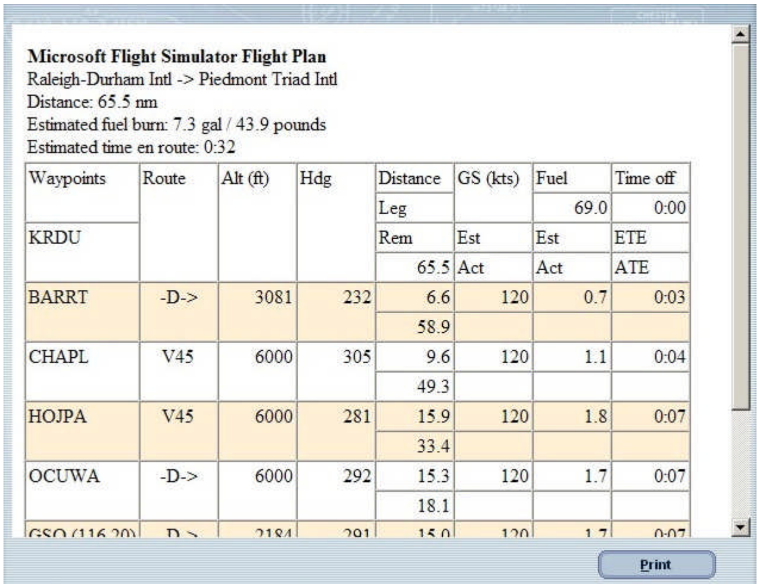
Microsoft Flight Simulator Flight Plan
Raleigh-Durham Intl -> Piedmont Triad Intl
Distance: 59.9 nm
Estimated fuel burn: 6.7 gal / 40.1 pounds
Estimated time en route: 0:29

Waypoints	Route	Alt (ft)	Hdg	Distance	GS (kts)	Fuel	Time off
				Leg		69.0	0:00
KRDU				Rem	Est	Est	ETE
				59.9	Act	Act	ATE
RDU (117.20)	-D->	947	197	1.3	120	0.1	0:00
				58.6			
CHAPL	V45	4000	282	13.0	120	1.4	0:06
				45.6			
SNOWS	V45	4000	281	13.1	120	1.5	0:06
				32.5			
HOJPA	V45	4000	281	2.8	120	0.3	0:01
				29.7			
KIMES	V45	4000	292	11.5	120	1.3	0:05
				18.2			
KGSO	-D->	925	301	18.2	120	2.0	0:09
				0.0			

Not For Operational Use

Figure 262 – The automatically generated default flight plan.

Figure 262 shows a printout of the flight plan automatically generated by the flight planner. You can see the flight plan (reference figure 263) by clicking on the NavLog button after creating the flight plan.



Microsoft Flight Simulator Flight Plan
Raleigh-Durham Intl -> Piedmont Triad Intl
Distance: 65.5 nm
Estimated fuel burn: 7.3 gal / 43.9 pounds
Estimated time en route: 0:32

Waypoints	Route	Alt (ft)	Hdg	Distance	GS (kts)	Fuel	Time off
				Leg		69.0	0:00
KRDU				Rem	Est	Est	ETE
				65.5	Act	Act	ATE
BARRT	-D->	3081	232	6.6	120	0.7	0:03
				58.9			
CHAPL	V45	6000	305	9.6	120	1.1	0:04
				49.3			
HOJPA	V45	6000	281	15.9	120	1.8	0:07
				33.4			
OCUWA	-D->	6000	292	15.3	120	1.7	0:07
				18.1			
GSO (116.20)	-D->	2184	291	15.0	120	1.7	0:07

Figure 263 - The NavLog screen view.

Notice the information provided on the flight plan. It provides the total distance in nautical miles, the estimated fuel burn in gallons and pounds, and the estimated time en route at the top. The table consists of columns and rows, each row listing a waypoint, with the associated routing, expected altitude, heading to the waypoint from the previous waypoint, the distance to the waypoint from the previous waypoint and total remaining distance, ground speed expected along the leg, estimated fuel burn for each leg, and estimated time en route on each leg.

It should also be noted that during the actual flight the NavLog screen will automatically log (update) the actual ground speed during each leg, the actual fuel burn during each leg, and the actual time en route during each leg (basically all the blank fields). If the pilot loads an approach into the GPS and activates it the automatic logging will cease at the waypoint where the approach is activated.

Now that we have a basic route built we need to modify it to better suit our needs. This is where we apply the tips and tricks that will make this plotted route much more efficient for online ATC activities. Remember, once the flight plan is submitted it is loaded into the flight simulator GPS 500 automatically. We want to ensure the waypoints loaded are correct for our flight before doing this.

Let’s think about the takeoff first. What is it that a controller will typically tell the pilot when departing? It might be something like this “N9COF wind 230@5 cleared for takeoff runway 23R climb to 3000 feet maintain runway heading.” The key instruction here is “maintain runway heading.” When planning a flight where the GPS will be utilized we need to think about lateral (path) navigation. The only part of the instruction pertaining to the path of flight is “maintain runway heading”. This is very common as most aircraft will climb straight ahead until reaching a safe altitude and then make an initial turn to proceed on route either via a loaded flight plan or by controller vectors. The pilot must always expect the controller to change things and be prepared to comply with the instructions.

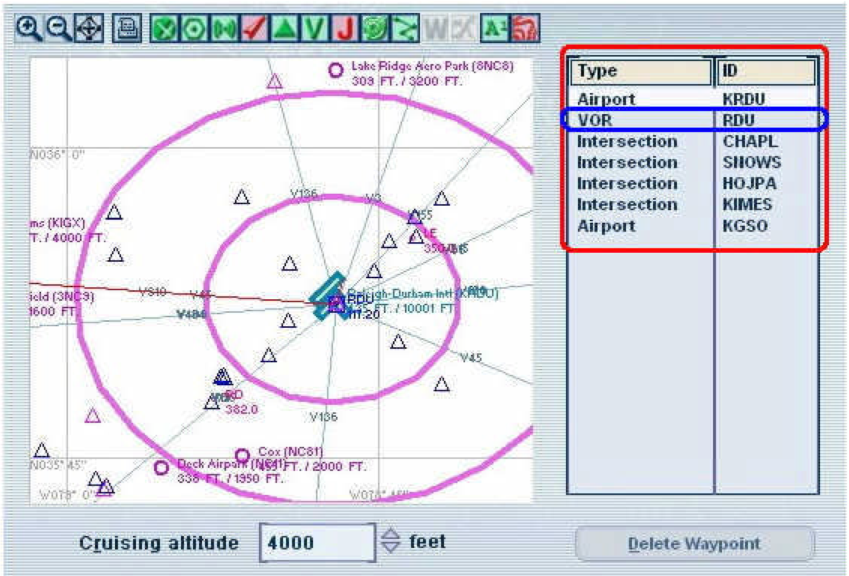


Figure 264 - The departure airport view.

In figure 264 (again the automatically generated flight plan) you can see the RDU VOR was selected as an initial waypoint. This is very unnecessary and problematic. Why? Well when the aircraft departs it would most likely be allowed to fly straight until well past the takeoff end of the runway (hence the common instruction from the controller to maintain runway heading) and most likely would never turn back to over fly the RDU VOR located on the airfield. It is like trying to use two waypoints at the same location, WHY? The airport itself is the initial waypoint (the departure point), so that is all you need here. Delete the RDU VOR from the list by highlighting it then clicking on the "Delete Waypoint" button.

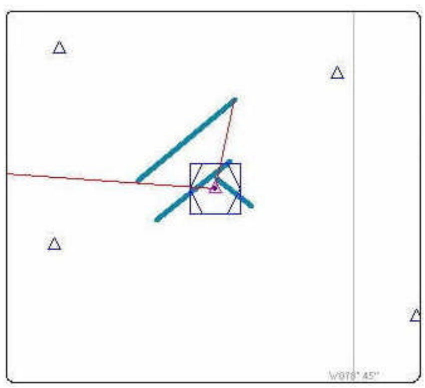


Figure 265 - Close up view of the KRDU default departure.

Now every good virtual pilot knows that shortly after takeoff when the gear has been raised (if required), flaps are being retracted, and the aircraft altitude is around 1000 feet AGL that the autopilot will usually get activated so the pilot can concentrate on other things (as simulator pilots we don't typically have the luxury of a co-pilot to help us out). We could just set the heading bug on the DG for the runway heading (and many a pilot does it that way due to controllers vectoring the aircraft) but what if we could build into the flight plan what is commonly expected. So why not select a waypoint some distance out from the airport on the runway heading that the GPS can continue to track to? If the tower or departure controller does vector you before reaching this waypoint then no problem, you can tell the GPS at that time to "skip" the first leg and to follow the second leg if it hasn't already sequenced itself. Chances are the controller will be vectoring you in the same general direction your first or second waypoint is located anyway (and it should be in your filed flight plan that is also loaded in the GPS). Let's find a better suited waypoint off the departure runway.

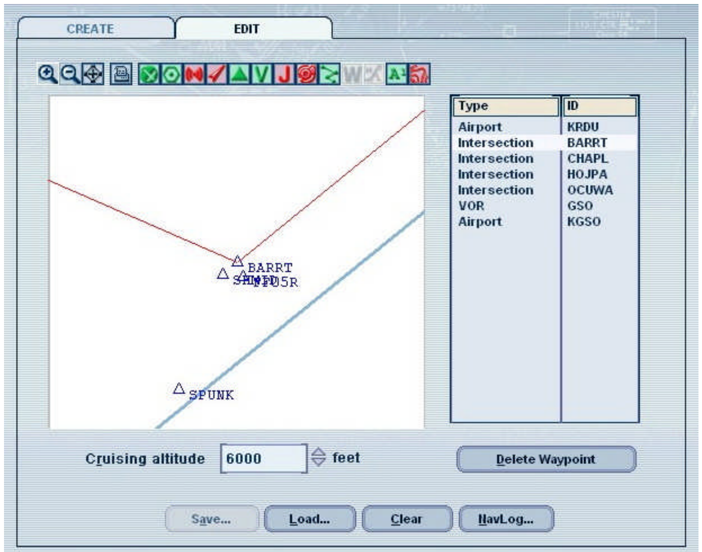


Figure 266 - Waypoint BARRT.

I found a waypoint in figure 266 conveniently located off the departure end of runway 23R at KRDU called BARRT. In figure 267 you can see how it fits into the big picture slightly better.

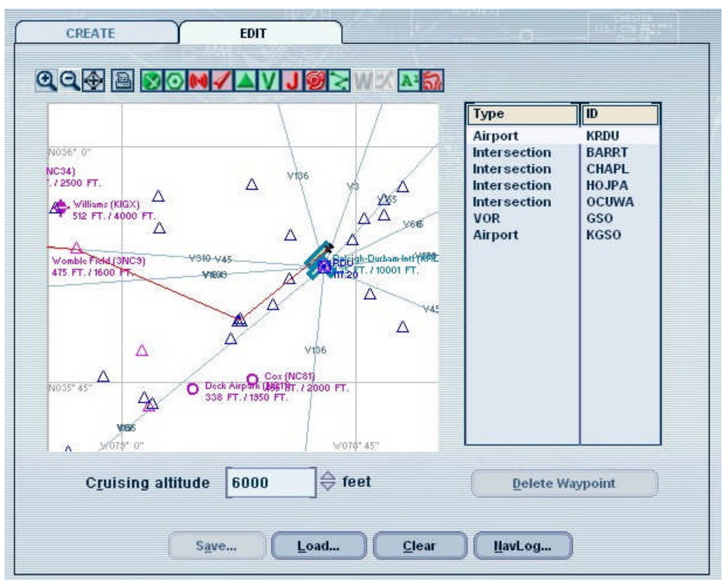


Figure 267 - The new departure route.

The virtual ATC controllers will expect to see something like this in your flight plan. The tower or departure controller will look at the first one or two waypoints to ensure that you are properly sent on your way just after takeoff whether you are cleared as filed or provided vectors. If the pilot doesn't properly file the flight plan then it will confuse the process. If the tower or departure controllers can visualize clearly what your intentions are by reading a good flight plan (via FSHost) then chances are they will accommodate you by providing an instruction maybe as follows "N9COF climb to 3000 feet and proceed on route as filed." This would allow you to immediately kick in the autopilot using the GPS or any other cockpit navigational aid. In such a case no vectors are required.

The departure and arrival phases of flight are the hardest on controllers to ensure your flight goes as *you* intended. Remember, they can not read your GPS so the only thing they can reference to understand your exact intentions is the filed flight plan via FSHost. If you fail to put specific waypoints in a flight plan then they may not guide you on your way according to what you have loaded in your GPS. This is why using the NavLog can help you file a better flight plan once the proper waypoints are loaded because that is what will be loaded into the GPS.

For instance, let's say you have filed this flight plan via FSHost using the NavLog.

IFR N9COF CESSNA 182 KRDU 6000 KGSO KCLT

According to this flight plan the controllers are going to expect you to fly on a straight line from KRDU to KGSO at 6000 feet MSL as per the blue line in figure 268. No airways, no turns, nothing other than a straight line. It doesn't mean you fly away from KRDU for 50 miles to point X and then fly toward KGSO (unless the controllers clear you to do this) it means your course of flight is on the straight line drawn directly between the two. In such a case the tower and departure controller's initial clearances will be to turn you so you can get on the blue line as quickly as possible. Once they release the pilot to fly the intended route as filed you are expected to stay (fly) on this blue line per the flight plan filed above.

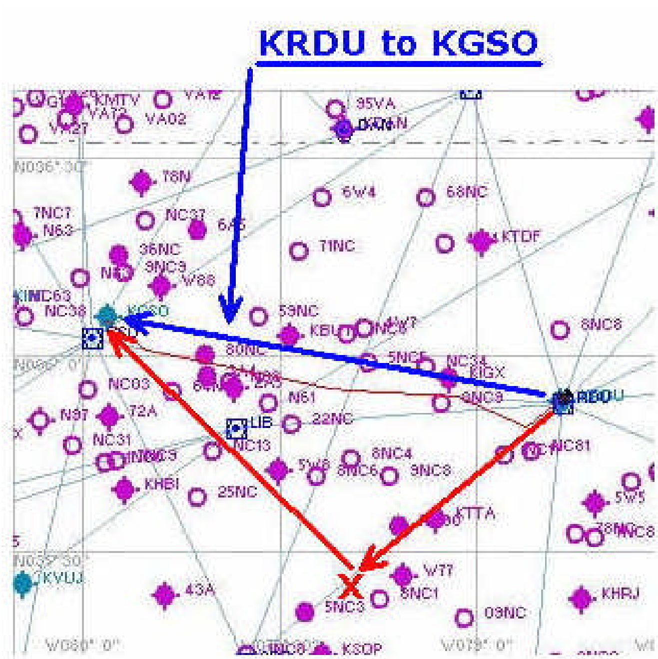


Figure 268 - Flying a direct route.

If you do wander off this blue line the controller is obligated to correct your course of flight by vectoring you. If on the other hand you did get as far out as point X because of ATC instructions then the controller may clear you to KGSO direct as follows "N9COF turn heading 300° cleared direct KGSO." What the controller has just done is provide you a new clearance other than the one issued in your original flight plan. They are pointing you in the direction of your destination (300°) and telling you to fly from your *current position* (say point X in figure 268) directly to your destination KGSO. In such a case you could now use the GPS direct-to button to override your loaded flight plan because the original flight plan is no longer needed. At this point you are expected to stay on the red line between point X and the destination.

Another issue that arises during multiplayer activities just after takeoff is when the autopilot is fed erroneous information due to a badly loaded flight plan or because proper route sequencing has not occurred that takes the aircraft somewhere other than what ATC expects. For instance, a controller gives you this clearance "N9COF turn to heading 280° then cleared as filed" pointing you in a direction that should be an intercept course to the filed route and putting the pilot back in control of guiding the aircraft along the intended route of flight. Typically the pilot will hold the 280° bearing using the heading bug on the DG until intercepting the intended route (you do know where the route is correct?). At that point the pilot typically activates the GPS to guide the autopilot. If the aircraft doesn't react as expected when you activate the GPS the pilot needs to quickly take manual control of the aircraft, staying on the proper route until the problem can be sorted out. Don't let the aircraft wander from the route or in extreme cases turn completely around. This should never happen! The controller will be going ballistic behind his/her microphone <grin>.

The GPS 500 will typically auto sequence the route as the flight progresses so when it comes time to activate it things should react properly, but it behooves the pilot to check the GPS often to ensure the proper leg on the route is selected. Remember other cockpit devices or flight utilities might not sequence properly. It is up to the pilot to ensure they know how to operate whatever navigational device they are using. FS Navigator used by a pilot can be confusing depending on internal configuration settings. Flight management computers (FMCs) are the same way. Also, pilots often use flight plans generated by their favorite virtual airline that may not take into consideration any of these points we discuss here. *So check the flight plan before loading it and know how to operate your navigational devices!*

Let's continue now to the next waypoint listed, CHAPL, it is the first waypoint along the airway V310/45 (consider it the waypoint where you jump onto the airway). This works well so leave CHAPL as is.

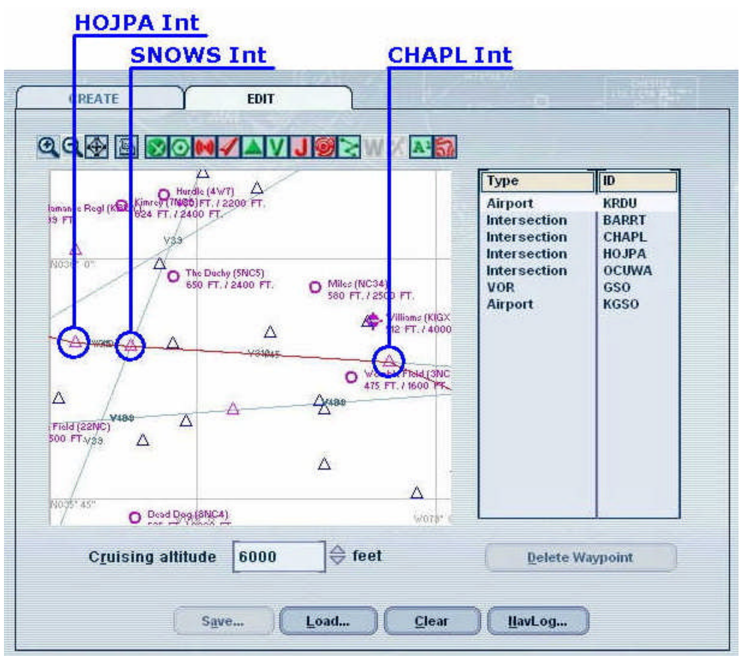


Figure 269 - Intermediate waypoints along an airway.

If you look at figure 269 you will notice that there are no turns or airway changes required for our route between CHAPL and HOJPA intersections, so the SNOWS intersection is not required as automatically generated (note the SNOWS intersection is already deleted in figure 269). It is considered an extra waypoint between two other distinct waypoints that make a leg. A leg only requires two points. So delete this waypoint as described before. Keep the route of flight as simple and uncluttered as possible. Only include intersections, fixes, waypoints, or NAVAIDs that are absolutely required. A rule to apply here is to include any waypoint required to mark an in-flight airway change or a turn along the route.

Let me show you an example of this rule. Take a look at figure 270 which shows the intersection SNOWS on a partial view of FS Navigator (the controller's scope).

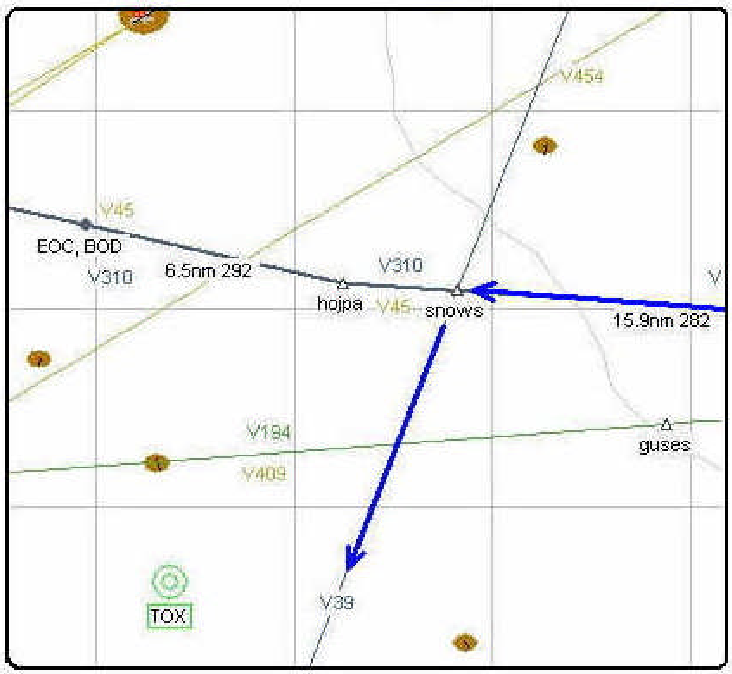


Figure 270 - Airway change.

Let's say our route of flight would take us south along V39 from the intersection with V310/45 (the SNOWS intersection). It would now be absolutely necessary to include this waypoint in the flight plan because it marks an airway change in the route.

Why? Because airways can go for hundreds, even thousands of miles, so when a controller starts looking for the intersection they need a fast way to locate it (it's a controller thing <grin>). If the pilot doesn't list the intersection identification (ICAO) in the flight plan then the controller has to manually click along the airway hoping they'll find the intersection (sometimes impossible to do!).

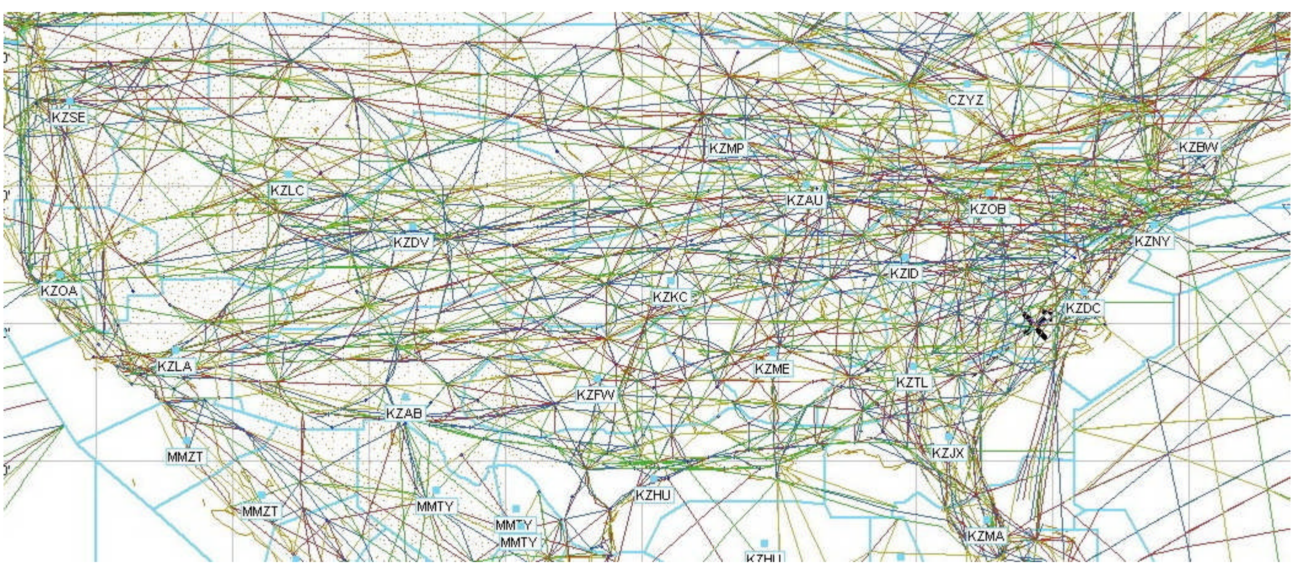


Figure 271 - FS Navigator view of Victor and Jet Airways in the USA.

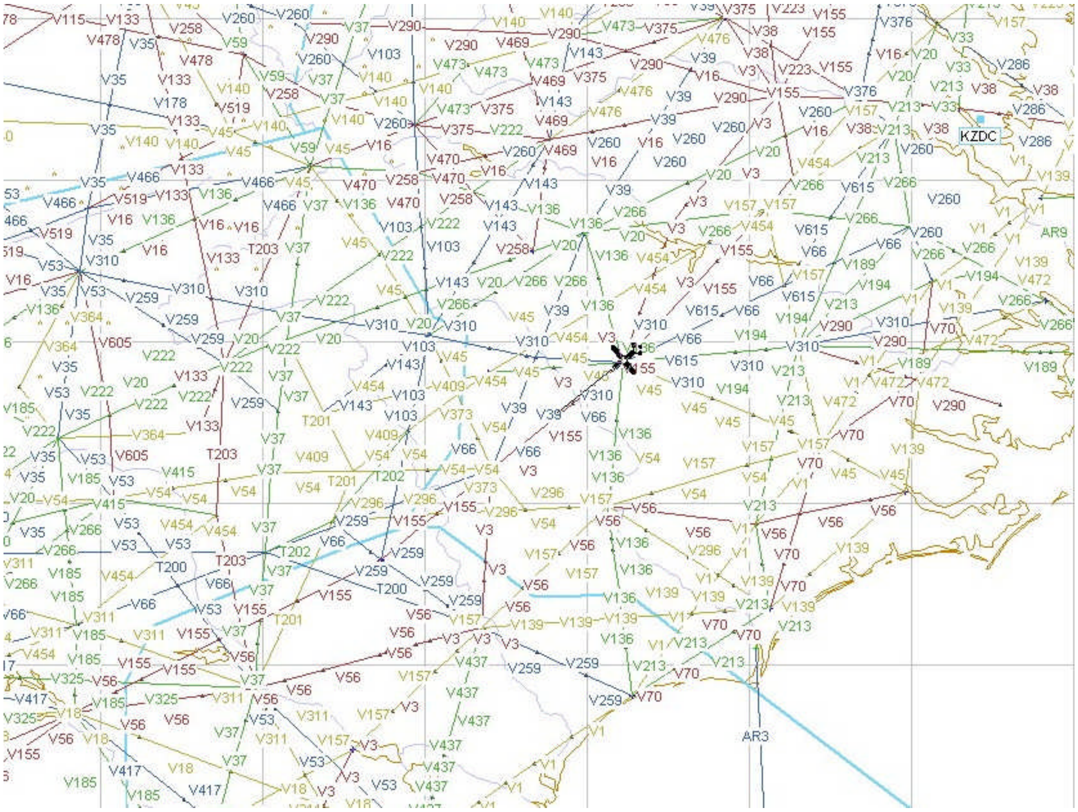


Figure 272 - FS Navigator view of Victor Airways near KRDU (The aircraft is sitting at the KRDU airport).

If they are busy this can get very frustrating for them as they can not watch other aircraft while moving the map around to find the intersection, *especially while controlling on a global basis*. Look at this hypothetical flight plan filed through FSHost.

VFR N9COF CESSNA 182 KRDU 6500 RWY23R BARRT CHAPL V45 V39 SDZ FLO RWY27 KFLO

If a controller looks at this flight plan then goes to FS Navigator (reference figure 272) to locate the intersection of V310/45 and V39 they may not find it easily. FS Navigator does provide a way to search for fixes so if the pilot properly provides the fix in the filed flight plan then the controller can type the identifier in which will list all matching identifiers in the database allowing the controller to locate the intersection along the airway in a timely manner. So pilots should always cooperate by properly filing flight plans. The filed flight plan above would be properly written like this.

VFR N9COF CESSNA 182 KRDU 6500 RWY23R BARRT CHAPL V45 SNOWS V39 SDZ FLO RWY27 KFLO

If a controller reads this flight plan strip then they'll know that the intersection for V310/45 and V39 meet at the SNOWS intersection. They can search for SNOWS and quickly find the intersection. Now they'll know you'll connect to V39 headed toward the SDZ VOR on to the FLO VOR arriving at your destination at KFLO.

Now back to where we were, the next waypoint (intersection) to check is HOJPA, which provides a slight turn along the route. Turns should always form the start of a new leg. Again this is just a virtual method of helping the controllers clearly visualize the route of flight. If the pilot enters this waypoint in the flight plan then it is much easier looking at FS Navigator to realize (because it is listed in the flight plan) that something will occur at the HOJPA intersection. The controllers will make a note to check it.

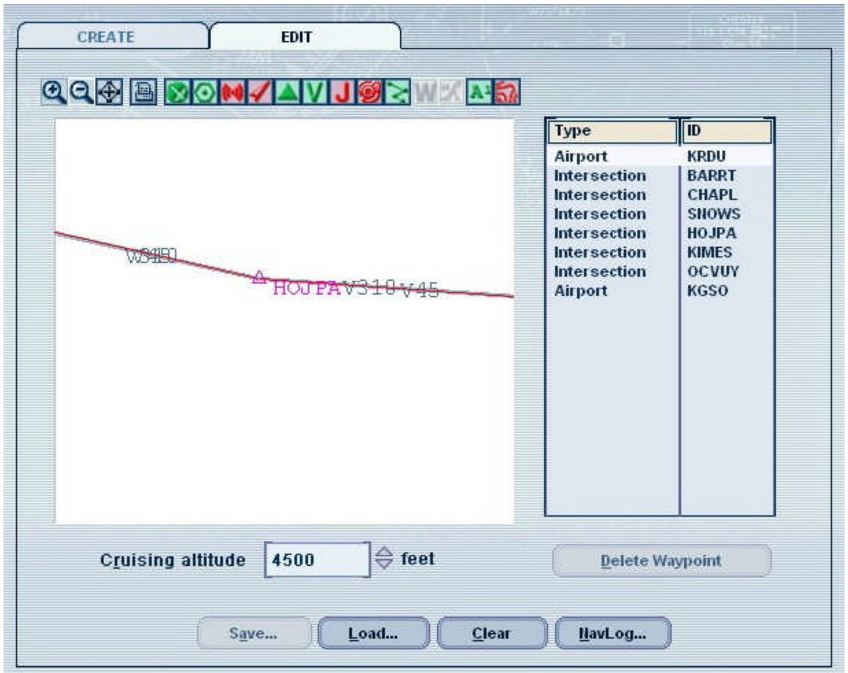


Figure 273 - Slight turn en route at HOJPA intersection.

Now, as the aircraft approaches the destination airport, at some point the aircraft will need to leave the airway to line up to the runway for landing. Here we run into several issues for online controllers and pilots that require some education and understanding. Unlike departures, arrivals tend to be more complex due to the uncertainty of the transition and approach to be used for landing and who will conduct them, either the controller or pilot. If the controller provides a virtual pilot vectors-to-final then most of the issues are eliminated (and is the typical method used because it is the simplest), but what if the pilot wishes to challenge their skills and conduct a SID, STAR, or a specific instrument approach to a runway using the GPS (or an FMC)? This will create unique issues for the virtual pilot and controller. Let's discuss this for a moment.

In real-life, transitions and approaches are typically chosen by the controller but conducted by the pilot. The controller has many considerations when choosing the arrival transition, approach to be used, and the runway for landing. The direction the aircraft is approaching the destination airport, the amount of airport traffic, and the simulated weather (specifically the wind direction and speed) are good examples. *The controller's choice for the primary landing runway should always be based on the best runway available that can be used based on the simulated weather (particularly the wind direction and speed).* When the controller makes the selections for the transition and approach and provides a proper clearance then it is up to the pilot to conduct these as published on available charts and maps (that they should always have available) and manually fly the aircraft through the required procedures or couple the GPS or FMC (preloaded with the required procedure) to the autopilot to allow either to guide the aircraft through the arrival and approach.

The difference (problem) between real-world operations and virtual operations is that not all virtual pilots have printed charts and maps available due to the cost or because they don't know where to download them for free from the Internet. So this is a situation where we bend the rules to fit the game. Most transitions and instrument procedures are available to virtual pilots via databases that come with the GPS or are provided with other navigational devices such as an FMC. They don't have them in printed form but they can, with the proper skill, load them via these databases into a navigational device that can guide the autopilot.

FS Navigator depicts ILS and back course approaches on the map. So these are typically used by controllers during online activities because they know where the points are to provide pilots with the proper clearance at the correct times. They wouldn't typically advise the pilot to expect a VOR DME Arc approach because the routes required to conduct these can not be displayed properly on the FS Navigator map (a problem faced from the controllers perspective). The waypoints and such are there but the controller doesn't have the route overlays to monitor the approach and provide proper clearances at the correct time. This is why ATC services get "stuck in a rut" doing ILS approaches all the time when using FS Navigator as the scope. It is a software limitation.

For instance, if the pilot wished to conduct the VOR DME Arc instrument approach to runway 23 at KGSO it isn't a problem because they can load it into the GPS in snap (because it is in the GPS database). But you'll find the controller now reluctant to do this for the reasons described above. The problem is the controller will not know when to provide the proper clearances during the approach because the controller can not see the approach waypoints on the FS Navigator map (it isn't that they aren't there, it is because the controller has no easy way to chart the approach on the FS Navigator map). Now the shoe is on the other foot, as it would be up to the controller to have the chart for the KGSO VOR DME Arc approach to runway 23 to locate the waypoints where proper clearances would need to be issued.

So in the end this is why I always recommend that any transition or approach that might be used during an activity be made available to both the pilots AND controllers. The easiest way to do this is for the ATC service to make available FTP space where any chart that might be required during an activity can be downloaded to all participants. It is a little work but can have a very positive impact on the fun!

One other note here about the GPS concerning transitions. The GPS database by default has most instrument approaches available with the various transition points for these. On the Active Flight Plan page near the bottom there is a space that shows two lines for departures (SIDs) and arrivals (STARs) but for some reason these are not in the GPS database? If a pilot wishes to conduct a SID or STAR then another navigational device with such a database must be used. The FS Navigator database can be easily updated with SIDs and STARs data that pilots can use within flight plans that FS Navigator is designed to create for pilots. The pilot can then use FS Navigators autopilot feature to guide the aircraft per this plan. Be aware that some of these may not be official SIDs and STARs but made by individuals to emulate them.

So now you have a better picture of what is going on from the pilot's and controller's perspective, if a controller picks the transition and approach the pilot will need the charts (or data loaded into a navigational device) to conduct them as instructed. If the pilot requests a specific transition or approach then the controller will need the proper charts (or method to view the approach) to provide the pilot clearances at the correct time.

There is one exception (work around) to the second rule. The pilot can provide the ATC controllers what they need via the filed flight plan. That's right; the pilot can include the specific waypoints generated by whatever planning tool they use to help the controller see the transition or approach they will request to conduct. If filed properly on the flight plan strip the controller can more easily accommodate the pilot. So how does the pilot do this? Well, this brings us back to modifying the automatically generated flight plan. Let's continue.

I'm going to request (as the pilot) to conduct the VOR DME Arc approach to runway 23 at KGSO when I arrive. I could do an ILS but the reported weather (simulated of course <grin>) isn't all that bad so the DME Arc approach should do (if the controller approves my request?). Conveniently one of the initial approach fixes (IAFs) for the VOR DME Arc approach is located right on the airway V310/45 I'll approach the destination on. So this waypoint now becomes my expected "jumping off point" along the airway. The intersection is named OCUWA. The DME Arc is a 15nm arc (something that looks like a quarter of a circle) from the GSO VOR. So you can imagine the IAF for the arc will be on a specific radial from the GSO VOR at a distance of 15nm. Reference figure 274 which resembles the DME Arc as published on real-world charts.

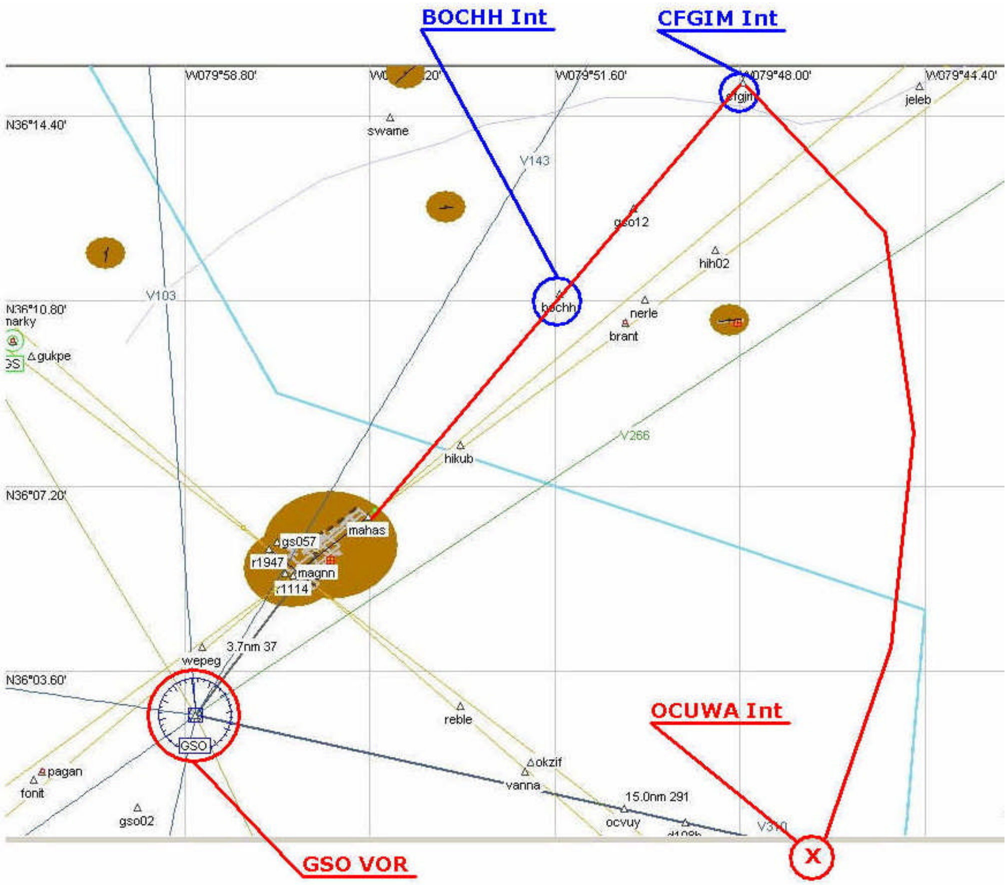


Figure 274 – FS Navigator view of OCUWA intersection and the VOR DME Arc approach to runway 23 at KGSO.

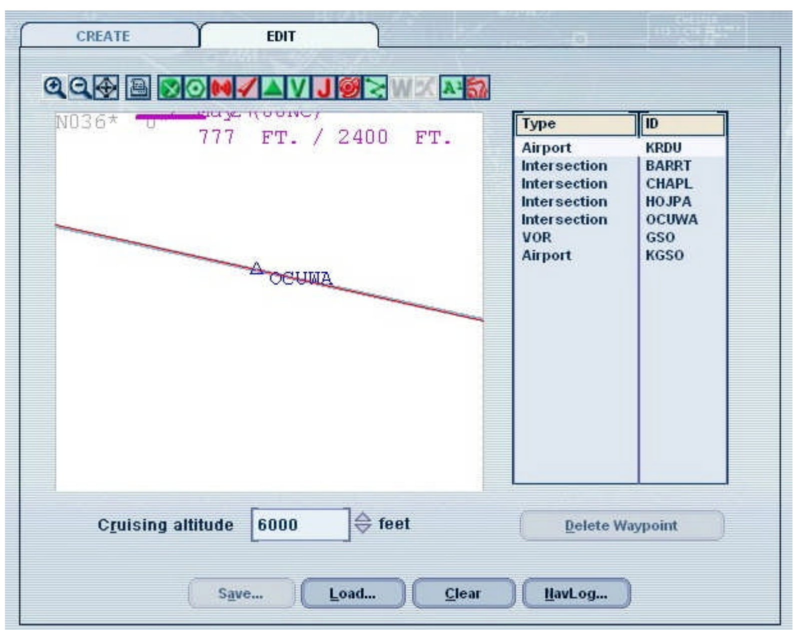


Figure 275 - Inserting the OCUWA intersection.

OCUWA is not in the automatically generated flight plan so you will have to insert it. To do this take the mouse cursor and place it on the red line depicting the route of flight then left click and hold it to drag it to the OCUWA intersection. If the red line is already on the intersection you must still grab the line and drop it on the intersection to get the "Select a Facility" window to pop up (reference figure 276).

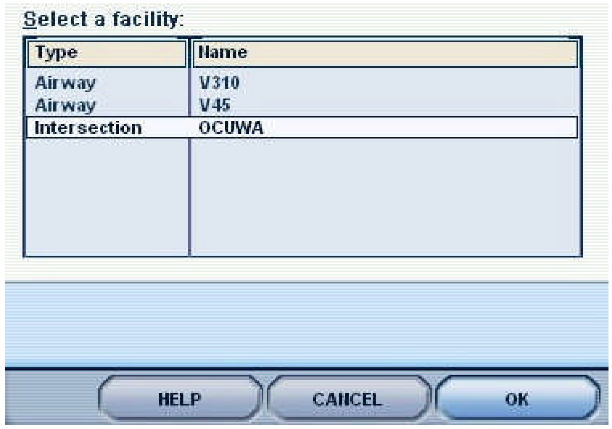


Figure 276 - Selecting a facility.

Notice that you can select either of the airways V310 or V45 and the intersection OCUWA. Highlight OCUWA and click OK to add the intersection to the flight plan. There is no reason to add all the waypoints for the approach to the flight plan, just the IAF will do. Why? Because this is the point the controller must know about to issue a clearance to allow the pilot to conduct the approach. Also, when the controller learns this is your IAF for the VOR DME Arc then the controller can easily picture the arc in there mind so monitoring the approach shouldn't be a major problem.

How does the controller find out about the VOR DME approach the pilot will request? Well, the approach controller typically will take control of the flight somewhere before the 60nm range from the destination airport. The approach controller has the responsibility at that time to tell the pilot the proper barometric setting for the altimeter (if the aircraft is flying below 18000 feet MSL) and what approach and landing runway to expect at the destination. If the pilot wishes to conduct an approach other than what the controller has chosen then this is the time to do it. Now the controller should understand what OCUWA is for (but it wouldn't hurt to tell the virtual controller that it is the IAF for your approach <grin>). Now the controller knows that your clearance to conduct the approach must be issued before reaching this waypoint. When the clearance is issued the pilot only needs to activate the approach in the GPS and it will fly the entire approach from that point forward. Sometime during the final part of the approach the pilot will be handed off to the tower controller as expected to receive the landing clearance.

If anything does go wrong during the approach tell the controller immediately, in which case the controller will probably provide vectors for the remaining portion of the approach or have the pilot proceed to a holding point until things can be sorted out.

Since we added OCUWA as the waypoint to exit the airway it makes the intersection KIMES an intermediate waypoint between two other distinct waypoints that form a route leg. This is the same situation that we had with the SNOWS intersection so you can delete this intersection.

Figure 277 now shows the final modified flight plan we just made. You can see it is simpler than what we had when we started and will be more efficient than the one automatically generated.

Microsoft Flight Simulator Flight Plan
Raleigh-Durham Intl -> Piedmont Triad Intl
Distance: 61.9 nm
Estimated fuel burn: 6.9 gal / 41.5 pounds
Estimated time en route: 0:30

Waypoints	Route	Alt (ft)	Hdg	Distance	GS (kts)	Fuel	Time off
				Leg		69.0	0:00
KRDU				Rem	Est	Est	ETE
				61.9	Act	Act	ATE
BARRT	-D->	3081	232	6.6	120	0.7	0:03
				55.3			
CHAPL	V45	6000	305	9.6	120	1.1	0:04
				45.7			
HOJPA	V45	6000	281	15.9	120	1.8	0:07
				29.8			
OCUWA	-D->	6000	292	15.3	120	1.7	0:07
				14.5			
KGSO	-D->	925	303	14.5	120	1.6	0:07
				0.0			

Not For Operational Use

Figure 277 – The modified flight plan.

Below is how the final flight plan shown in figure 277 would be filed via the chat window in flight simulator to FSHost. This is probably the most important part of planning the flight. If the pilot doesn't file the flight plan properly then things probably won't go smoothly from either the pilot or controller's perspective. Make sure to go over the section about flight plans thoroughly.

IFR N9COF CESSNA 182 KRDU 6000 RWY23R BARRT CHAPL V45 HOJPA V45 OCUWA RWY23 KGSO KCLT

Here is how the controller would interpret the flight plan strip. The pilot has filed an instrument flight plan (IFR) using a Cessna 182 with the call sign N9COF departing the Raleigh/Durham International Airport (KRDU) with a requested cruising altitude of 6000 feet. The expected runway for takeoff is runway 23R and the first fix after the takeoff is BARRT. The fix where the pilot will join the intended airway is CHAPL (the controller knows this because it is the first fix listed before the airway designation). The airway is Victor V45 (Victor indicates it is a low altitude airway for flights below 18000 feet MSL), always include the V (or J for Jet Airway) so the controller knows the difference. There is a turning point along the airway at HOJPA and the flight continues on V45 from there. The fix where the pilot intends to exit the airway for the arrival and/or approach at KGSO is OCUWA. The expected landing runway will be runway 23 at KGSO. The alternate airport for this IFR flight is Charlotte/Douglas International Airport (KCLT) in the event that the landing can not be made successfully at KGSO.

So you have now learned how to create and modify a flight plan using our concepts to better suit a virtual flight during a "live" ATC activity. You have also learned more about how to properly file the flight plan via the chat window in the flight simulator that the controller will read in FSHost. You also know about some of the pros and cons concerning navigational devices such as the GPS, an FMC, and FS Navigator.

GPS FAQS

Question 1: How do I turn off the airspace alert messages on the GPS 500?

Answer 1: If you're distracted by near-constant flashing of the message annunciator when flying in an area with lots of controlled airspace it's easy to temporarily disable the airspace alert messages.

To disable airspace alert messages click and hold the MSG button for at least two seconds. The message annunciator will display an OFF message in the space just above the message button. To enable the alerts just click on the button again.

Figure 278 - Disabling the airspace alert message.

Question 2: Can I connect the GPS to the VOR1 gauge (or HSI) and/or an autopilot or flight director?

Answer 2: Yes. If you're flying an aircraft featuring the GPS 500 there will be a NAV/GPS switch on the instrument panel. If you want the GPS to provide data to the VOR1 gauge (or HSI) and the autopilot or flight director make sure the NAV/GPS switch on the aircraft's instrument panel is in the GPS position. The VOR1 gauge (or HSI) needle (CDI) will indicate the course to follow to track the active flight plan or direct-to in the GPS and the autopilot or flight director will follow this course when in NAV mode. Remember to switch to Heading (HDG) mode during the vectoring phase of a vectors-to-final approach.

Question 3: What does the OBS button do and when do I use it?

Figure 279 - OBS button showing suspension of waypoint sequencing.

Answer 3: The OBS button is used to select automatic sequencing of waypoints. Clicking on the OBS button holds your current "active-to" waypoint as your navigation reference and prevents the GPS from sequencing to the next waypoint. A SUSP message displays directly above the OBS button. When you cancel OBS mode, automatic waypoint sequencing resumes and the GPS will automatically select the next waypoint in the flight plan once the aircraft has crossed the current active-to waypoint.

Question 4: Why won't my GPS automatically sequence to the next waypoint?

Answer 4: The GPS will only sequence flight plan waypoints when automatic sequencing is enabled (in other words when there's no SUSP message directly above the OBS button). For automatic sequencing to occur you must also cross the "bisector" of the turn you are navigating and be within 10nm of the active waypoint. The bisector is a perpendicular line between two flight plan legs which crosses through the waypoint common to both legs.

Question 5: How do I skip a waypoint in an approach, departure, or arrival?

Answer 5: The GPS allows you to manually designate any approach, departure, or arrival leg as the active leg of your flight plan. From the Active Flight Plan page highlight the desired waypoint and click the MENU button then click the ENT button to activate the leg. The GPS will then provide navigation along the selected flight plan leg, so be sure you have clearance to that position.

Question 6: When does the CDI scale change and what does it change to?

Answer 6: The GPS will begin a smooth CDI scale transition from 5.0nm scale (en route mode) to 1.0nm scale (terminal mode) when you reach a point 30nm from the destination airport. The CDI scale will further transition to 0.3nm scale (approach mode) within 10nm of the airport during an active approach. The CDI scale will also be 1.0nm (terminal mode) within 30nm of the departure airport.

Question 7: How do I reselect the same approach, or activate a new approach, after a missed approach?

Answer 7: After flying all missed approach procedures you may reactivate the same approach from the Procedures page for another attempt. Once you have been given clearance for another attempt, activate the approach from the Procedures page by highlighting "Activate Approach?" and then clicking the ENT button. The GPS will provide navigation along the desired course to the waypoint and rejoin the approach in sequence from that point on.

To activate a new approach for the same airport select the new procedure from the Procedures page.

To activate a new approach to a different airport create a direct-to.

Note that you should not attempt to reactivate the same approach you're currently executing prior to crossing the missed approach point (MAP). If you attempt to do so the GPS will direct you back to the transition waypoint and will not take into consideration any missed approach procedures.

GPS ABBREVIATIONS AND TERMINOLOGY

Abbreviations:

ACTV	Active
ALT	Altitude
APR	Approach
APT	Airport
ARSPC	Airspace
ARTCC	Air Route Traffic Control Center
ARVL	Arrival
BRG	Bearing To
CDI	Course Deviation Indicator
CLR	Clear
CRSR	Cursor
CTAF	Common Traffic Advisor Frequency
CTR	Center (see ARTCC)
CTS	Course To Steer
CUM	Cumulative
DEP	Departure
DIS	Distance
DME	Distance Measuring Equipment
DTK	Desired Track
ELEV	Elevation
ENR	En Route
ENT	Enter
ETA	Estimated Time of Arrival
ETE	Estimated Time En Route
FPL	Flight Plan
FPM	Feet Per Minute
FREQ	Frequency
FSS	Flight Service Station
FT	Feet
G/S	Glide Slope

GPS	Global Positioning System
GS	Ground Speed
HDG	Heading
ID	Identifier
ILS	Instrument Landing System
INT	Intersection
KHZ	Kilohertz
KM	Kilometers
KPH	Kilometers Per Hour
KT	Knots (or KNT)
LAT/LON	Latitude and Longitude
LCL	Local
LOC	Localizer
LRG	Large
°M	Degrees Magnetic
M	Meters
MED	Medium
MHZ	Megahertz
MI	Statue Miles
MOA	Military Operation Area
MPH	Statue Miles Per Hour
MPM	Meters Per Minute
MPS	Meters Per Second
MSG	Message
MSL	Mean Sea Level
MUL	Multicom
NATNL	National
NAV	Navigation
NAVAID	Navigational Aid
NDB	Non-Directional Beacon
NM	Nautical Miles
NRST	Nearest
NUM	Number
OBS	Omni-Bearing Selector
PROC	Procedure(s)
PWR	Power
RAD	Radial
REF	Reference
REQ	Required (or Requirements)
RESTRICTD	Restricted
RNG	Range
RX	Receive
SML	Small
SPD	Speed
SRFC	Surface
SUA	Special Use Airspace
SUSP	Suspend Waypoint Sequencing
°T	Degrees True
TAS	True Airspeed
TERM	Terminal
TKE	Track Angle Error
TMA	ICAO Terminal Control Area
TRANS	Transition
TRK	Track (also Ground Track)
TRSA	Terminal Radar Service Area
TWR	Tower
UNIC	Unicom
UTC	Universal Time Coordinated (also GMT or Zulu)
VAR	Variation

VFR	Visual Flight Rules
VNAV	Vertical Navigation
VOR	Variable Omni-Range
VS	Vertical Speed
VSR	Vertical Speed Required
WPT	Waypoint
WX	Weather
XTK	Cross Track Error

Terminology:

ALT (Altitude)	Height above mean sea level (MSL).
BRG (Bearing)	The compass direction from your current position to a destination waypoint.
CAS (Calibrated Airspeed)	Indicated airspeed corrected for instrument errors.
CTS (Course To Steer)	The recommended direction to steer in order to reduce course error or stay on course. Provides the most efficient heading to get back to the desired course and proceed along your flight plan.
CUM (Cumulative Distance)	The total of all legs in a flight plan.
DIS (Distance)	The great circle distance from your current position to a destination waypoint.
DTK (Desired Track)	The desired course between the active FROM and TO waypoints.
ETA (Estimated Time of Arrival)	The estimated time at which you will reach your destination waypoint, based upon current speed and track.
ETE (Estimated Time En Route)	The time it will take to reach the destination waypoint, from current position, based upon current speed and track.
GS (Ground Speed)	The velocity you are traveling relative to a ground position.
HDG (Heading)	The direction your aircraft is pointed, based upon indications from a magnetic compass or a properly set directional gyro.
IND (Indicated)	Information provided by properly calibrated and set instrumentation in the aircraft panel (ex. "indicated altitude")
TKE (Track Angle Error)	The angle difference between the desired track and your current track.
TRK (Track)	The direction of movement relative to a ground position; also referred to as "ground track".

EMERGENCY PROCEDURES

Flight simulator is fully capable of simulating in-flight emergencies. As such it is necessary to cover some basic responsibilities, authorities, and procedures for the occasional virtual emergency. During online multiplayer activities it is not unusual for a pilot to be trying out a new complex aircraft and run into problems, or for a seasoned pilot to setup their simulator to experience a random aircraft failure now and then. When the crap hits the fan the virtual pilot needs to put on the thinking cap, keep a steady hand, and do like the real pilots do, and trust me they don't hit the pause button <grin>. Play it like it happens, sit up straight and get on the problem, fly the aircraft first and sort the problem out as you go along. Tell the controllers what is up and request any assistance required such as a change in altitude due to losing an engine. While your busy flying the aircraft checking out the problem you can get someone else on the radio (the controller) to sort out where you are and need to be headed so if all else fails you don't end up in the "drink" or like bug splat on the side of a mountain <grin>. The controllers probably won't mind the occasional diversion from the norm as that is part of the game. Sometimes even the controllers purposely pop things on the pilots like a terrorist act at an airport, or a major crash, or even simulated weather that closes an airport causing pilots to divert with little notice. All simulated of course. Depending on how the host server(s) are configured it is not entirely impossible to have the controllers lose their radar "picture" due to losing the FSHost server or even losing communications because of a problem with the TeamSpeak host server. It has happened before and chances are will happen again. Do you know what to do in such cases? That is what I'll discuss in this section. Things that every pilot and controller should be aware of so they can act appropriately and make the online activity finish successfully even under imperfect conditions.

PILOT RESPONSIBILITY AND AUTHORITY

AIM 6-1-1 states the pilot-in-command of an aircraft is directly responsible for and is the final authority as to the operation of that aircraft. In an emergency requiring immediate action, the pilot-in-command may deviate from any rule in 14 CFR Part 91, subpart A, General, and subpart B, Flight Rules, to the extent required to meet that emergency. If you're curious 14 CFR Part 91 is the Code of Federal Regulations and Part 91 pertains to General Operating and Flight Rules. The Code of Federal Regulations is maintained by the National Archives and Records Administration and can be found here http://www.access.gpo.gov/cgi-bin/cfrassemble.cgi?title=200214.

AIM 6-1-1(b) goes on to state if the emergency authority of 14 CFR Section 91.3(b) is used to deviate from the provisions of an ATC clearance, the pilot-in-command must notify ATC as soon as possible and obtain an amended clearance.

AIM 6-1-1(c) states unless deviation is necessary under the emergency authority of 14 CFR Section 91.3, pilots of IFR flights experiencing two-way radio communications failure are expected to adhere to the procedures prescribed under "IFR operations, two-way radio communications failure" (reference 14 CFR Section 91.185).

The reason I include this section is because virtual pilots do get into trouble now and then <grin>. In these cases it is vital during a multiplayer activity for the pilot to simulate and advise the controller that something is wrong as per 6-1-1(b). Basically don't start doing your own thing without telling a controller you have a problem. Many pilots will totally forget the simulation trying to solve the problem. So don't forget to play it like it is (at least until you crash and burn <grin>). Keep a cool head, fly the aircraft first, but get the word out that things are abnormal.

AIM 6-1-1(c) is telling the pilot they are expected to follow the normal protocols for two-way radio communications failure (that I'll describe in detail shortly) if the emergency does not require them to deviate from 14 CFR Section 91.3. Basically if the communications failure is not an immediate threat to aircraft or persons then proceed using the proper guidance (see Communications Failure below).

DISTRESS OR URGENCY CONDITION

An emergency can be either a ***distress*** or ***urgency*** condition as defined in the Pilot/Controller Glossary. Pilots do not hesitate to declare an emergency when they are faced with *distress* conditions such as fire, mechanical failure, or structural damage. However, some are reluctant to report an *urgency* condition when they encounter situations which may not be immediately perilous, but are potentially catastrophic. An aircraft is in at least an *urgency* condition the moment the pilot becomes ***doubtful*** about position, fuel endurance, weather, or any other condition that could adversely affect flight safety. *This is the time to ask for help*, not after the situation has developed into a *distress* condition.

Pilots who become apprehensive for their safety for any reason should ***request assistance immediately***. The controllers are ready and willing to help in the form of information, radar, and providing directions as required during your activity. Don't wait until you're going down to tell someone you are in trouble.

Need I say more? When flying in a multiplayer activity *urgency* conditions are similar things like described above, extremely low fuel, not being able to handle the weather, or if lost, but where the aircraft is still capable of flying in a stable normal condition. An urgency condition exists the moment the pilot becomes *doubtful* about any condition affecting flight safety. In such a case tell the controller what the problem is and they will help you sort it out ***BEFORE*** the conditions escalate to a distress condition where the pilot is totally absorbed in trying to keep the aircraft under control (this is when urgency conditions have gone to far and put the pilot and aircraft in a distress condition).

DISTRESS OR URGENCY PROCEDURES

Just as in real-life if an *urgency* condition arises then the pilot calls for help using the word **PAN-PAN-PAN** (preferably three times) warning all other stations and aircraft not to interfere with the urgency transmissions. If the aircraft and pilot are under *distress* conditions then the word changes to **MAYDAY-MAYDAY-MAYDAY** (again three times) and commands radio silence on the frequency in use. The only person to speak in such a case during an activity is the controller for the channel being used who will be trying to clarify what the problem is and what the next step will be. All others should continue their flights per the clearance (or clearance limit) received until the controller has time to issue further instructions.

In real-life the procedures to follow when trying to obtain assistance are as follows:

1. Climb, if possible, for improved communications, and better radar and direction finding detection (you can simulate this if you like). However, it must be understood that unauthorized climb or descent under IFR conditions within controlled airspace is prohibited, except as permitted by 14 CFR Section 91.3(b). In other words you must be in an urgency or distress condition to deviate from your assigned altitude.
2. If equipped with a radar beacon transponder *continue* squawking the assigned Mode A/3 discrete code/VFR code and Mode C altitude encoding when in radio contact with an air traffic facility or other agency providing air traffic service unless instructed to do otherwise (squawking Mode C ensures ATC receives your altitude information so they can keep other aircraft out of your way not only laterally but vertically).
3. *If unable to immediately establish communications with an air traffic facility/agency, squawk Mode A/3, Code 7700/Emergency and Mode C*.

When transmitting your distress message either for a MAYDAY (distress) or a PAN (urgency) include the following information:

1. Name of station addressed.
2. Aircraft identification and type.
3. Nature of the distress or urgency.
4. Weather
5. Pilots intentions or request.
6. Present position, heading; or if lost, last known position, time, and heading since that position.
7. Altitude or flight level.
8. Fuel remaining in minutes.
9. Number of souls on board.
10. Any other useful information.

Simulate all as best possible while participating in an ATC activity during your distress or urgency condition.

COMMUNICATIONS FAILURE

We all know things electronic and mechanical break. Just like computer hard drives it is not a question of *if* but more a question of *when*. It happens in the real-world of flying and believe it or not can happen in the virtual world of flying also. Let me explain some technicalities and scenarios here.

We have talked a little about the two host programs required to simulate our flying world in chapter 1, the first is FSHost which allows virtual pilots to connect their flight simulators to a central point to bring them all together in a virtual world. The second is TeamSpeak which provides a central communications system for those playing together in the FSHost virtual world.

Both of these hosting programs can run on a single server (one physical computer) or on separate servers (two physically different computers). Why would you do this? Redundancy is the primary reason. Having two separate computers allows the administrators a way to keep part of the system alive when the other goes down. Depending on how they setup each hosting program, they can also be used in a combination that will allow just one physical computer to be used when normal maintenance is required (not the optimal configuration). This is done by loading both host programs, FSHost and TeamSpeak on each physical computer. In other words computer A would have both host programs, FSHost and TeamSpeak loaded on it and computer B would have both host programs, FSHost and TeamSpeak loaded on it. If computer A required maintenance then you can run both host programs on computer B or vice versa. The normal setup (optimum configuration) would be to run the host program, FSHost on computer A and run the host program, TeamSpeak on computer B or again vice versa. The only thing everyone has to keep straight is the IP addresses and ports being used to access the host programs.

Note also that if the ATC service uses the optimum configuration, FSHost running on computer A and TeamSpeak running on computer B, that if the FSHost loaded on computer B and TeamSpeak loaded on computer A are left up and running then if a failure occurs on a single computer A or B that the pilots and controllers can connect to the remaining good computer just by reconnecting using the proper IP address and port. This practically eliminates the possibility of a total failure during any ATC activity.

If the ATC service can not afford to have two separate physical computers and must load both host programs, FSHost and TeamSpeak on a single physical computer then if it breaks then both hosts go down. You loose not only the virtual world itself but also the communications system and that of course will bring everything to a screeching halt except for the pilots who can continue flights on there own personal computers without being connected to the multiplayer system, but where's the fun in that <grin>?

There is also a side issue about power failures, say during stormy weather. It is a common misunderstanding that an uninterruptible power supply (called an UPS) can keep things running smooth but this is not exactly true. They will only provide a *time limited* power source and protect the system from *power fluctuations, spikes, and other power anomalies* allowing the administrator a safe period of time to *shut the system off* until things are rectified. UPS units run on batteries, when the regular line power fails these batteries typically will only last a short period of time depending on the size of the UPS unit, charge status, and the power demands required by the computer. Smaller UPS units will keep the computer and essential equipment running smooth for about 15 to 20 minutes if fully charged. If the regular line power source is backed up via a power generator then the UPS unit serves primarily to smooth out the power spikes that will occur during switching of the sources from upsetting the computer system. *A backup generator is the only true way to keep the computer system running for an extended period when the line power source has failed.* So depending on the ATC services resources they may have the capability to all, part, or none of the above.

Now if you place the virtual world (FSHost) on one physical computer and the communications system (TeamSpeak) on a second computer as previously stated, if one of the computers goes down the other system remains operational. So what can this simulate? If the virtual world (FSHost) goes down then this would simulate the failure of the Air Traffic Control radar system. The failure of FSHost does not prevent pilots from flying on their simulator on their personal computers (all that happens is they get disconnected from the host) but in this case we are possibly left with a way to communicate because chances are the communications server will still be up and running (we hope <grin>). So the controllers and pilots can still communicate with each other (very similar to what might happen in real-life) and in such a case controllers can still issue commands based on the last given *traffic picture and mandatory compulsory reporting points by the pilots*. As in real-life this can be simple or it can be a hair raising event. Cool heads will prevail <grin>.

The controllers can issue restricted clearances to pilots in such cases and use other techniques to manage traffic flow until they can sort things out and the controllers will rely on the pilots to tell them there current locations via the mandatory position reports so as to facilitate issuing proper commands to keep aircraft separated. The controllers will still have the *radar map*, in other words they can still see all the air routes, fixes, airports, and information their computer system provides because they like the pilots are still running FS Navigator on their personal computers. So sequencing air traffic through only voice communications (without a radar picture) is not entirely impossible. The only thing lost is the *radar blimps* that show the current aircraft positions (from losing the actual connection via FSHost).

If it is the other system that fails (the TeamSpeak server) then controllers will continue to have the *radar picture* via the FSHost server but will lose communications with ***all*** the pilots (*remember that the communications host connects **all** the players together just as FSHost connects all the players together into one virtual world*). So you can sum up the two failures like this, *the loss of the radar picture becomes the **controller's** burden*, but *the loss of the communication system becomes primarily the **pilot's** burden*. That is what we will discuss now, the pilot's burden, *what to do if communications are lost?*

In the virtual world as in real-life procedures for lost communications don't come without some complexity, but I'll try and keep it simple for virtual use. The following discussion provides guidelines to help the pilot to react properly to a communications failure. By reacting properly to a communications failure the controllers will have a *fair idea* while watching the radar blimps what each pilot's next movement *should* be. You would think the pilot would just fly to the destination and land but this is not exactly true, there are things a pilot must try to accomplish per these guidelines, and one of the primary things *is to arrive at the destination airport as close as possible to the estimated arrival time per the flight plan* so ATC can route or hold other traffic to provide the pilot a *slot to land without creating a traffic conflict*.

Of course the controllers are going to try and resolve the TeamSpeak failure as quickly as possible; it may only be temporary, say the time it takes to reboot the system. Pilots should remain patient and watch for messages via the FSHost chat (remember FSHost does have a chat system and the controllers can access this via FSHost to send messages to the pilots).

Aircraft literally *can not stop and park* while airborne (at least if you don't hit the pause button or are flying in a helicopter <grin>) but will always be in constant motion in one form or another, so there must be a way to manage traffic flow, possibly even *delaying an en route aircraft* for many a reason, *with and without* communications failures. We'll discuss something called a *holding pattern* later as a method to delay (or hold) air traffic as a means of sequencing air traffic. Until then keep in mind holding patterns can be required of the pilot during communications failures as discussed here.

Chapter 6 Section 4 of the AIM discusses Two-Way Radio Communications Failures for every bit of 1.5 pages worth. Paragraph 1(a) tells the pilot that the regulations can not cover every possible situation that may occur during a failure (that doesn't mean we can't use basic guidelines though and we do) so it is incumbent of pilots to use common sense and judgment when confronted by a situation not covered (this goes for online multiplayer activities also). Even though a communications failure *may **not** be a true emergency and immediate threat to life and limb* the AIM states if the situation dictates a pilot should not be reluctant to use the emergency action contained in FAR 91.3(b) which basically states <u>in an in-flight emergency requiring immediate action, the pilot in command may deviate from any rule of this part to the extent required to meet that emergency</u>.

In real-life there is a multitude of alternate ways to establish verbal or even textual contact with ATC in the event of communications loss and to pass information to them and vice versa. In the virtual world we are severely hampered as described above with only a few methods of communication via the host software on the servers. When all else fails we must reference a common set of guidelines to work from, so let's review the real-world rules as a starting point and then apply it to virtual capabilities.

1 – If a failure occurs in VMC (Visual Meteorological Conditions) or if VMC conditions are encountered after the failure, *each pilot* (I say *each pilot* in this case because ***all*** *pilots* will experience the failure on the server unlike just one in real-life) should endeavor to continue the flight under those

conditions and *land as soon as practicable* at the nearest available airport. In other words, after a communications failure if you find *clear air* (depending on the weather being simulated) it might be a wise decision to stay in it and land as soon as practicable (*just like a VFR pilot would do*). Remember that the VFR conditions that must exist are conditions that allow the pilot to *navigate completely by visual means* and *land with a visibility of 3 miles or better*. If these conditions can not be met then you must follow the communications failure guidelines as they apply to IFR operations.

The primary objective of 14 CFR Section 91.185 is to *preclude extended IFR operations* by aircraft *experiencing communication failure* within the ATC system, FAR 91.185(b) *IFR Operations: Two-Way Radio Communications Failure* states that if the failure occurs in VFR conditions, or if VFR conditions are encountered after the failure, each pilot shall continue the flight under VFR and land as soon as possible. A special note in the AIM 6-4-1 (c), (2) states that pilots who experience a communication failure should recognize that operation under these conditions may unnecessarily as well as adversely affect other users of the airspace, since ATC may be required to reroute or delay other users in order to protect the failure aircraft. However, *it is not intended* that the requirement to *land as soon as practicable* be constituted to mean *as soon as possible*. Pilots retain their prerogative of exercising their best judgment and are not required to land at an unauthorized airport, at an airport unsuitable for the type aircraft flown, or to land only minutes short of their intended destination. This rule also applies to aircraft flying in Class A airspace, in other words aircraft flying at or above 18,000 feet up to and including 60,000 feet. Typically this covers the area where most commercial aircraft will fly.

Think about this a moment in virtual terms, the controllers who still have an operational FSHost system can manage the simulated weather. Depending on the nature of the failure (whether they believe they can fix the failure in a timely manner) they can either leave the weather in an IFR state (basically telling the pilots to keep going by the rules to be given in number 2 below) or if they are not going to be able to fix the problem switch the weather to VFR (giving all pilots the choice to continue uninhibited or to land as soon as practicable as would apply in real-life). Play the activity through as is presented.

2 – If you are in IMC (Instrument Meteorological Conditions) or if you can not comply with number 1 above then the pilot continues the flight in accordance with the following:

A. Route (Lateral Navigation).
    1. Each pilot proceeds by the *last route assigned* in the *last ATC clearance received*.
    2. If the pilot is being *radar vectored*, by direct route from the point of failure to the fix, route, or airway specified in the vector clearance.
    3. In the *absence of an assigned route*, by the route ATC has advised may be *expected in a further clearance*.
    4. In the *absence of an assigned route* or a route ATC has advised may be *expected in a further clearance*, by the *route filed in the flight plan*.

    Okay, I know, you're asking what does this *really* mean. The rules above are telling the pilot how to proceed on the lateral navigation portion of the flight (*the route or path*) in conjunction with communications loss. Later, part B below will cover the vertical navigation portion of flight (altitudes) during communication failures.

    The AIM surprisingly doesn't provide a single example for properly following the guidelines as applied to the lateral portion of flight during communications failures. I guess they consider it self explanatory but I choose to believe there are some things that can be broke down a bit for better understanding.

    In the rules above you may notice there are specific portions shown in italics such as radar vectored, assigned route, last clearance received, expected in a further clearance, and filed flight plan. It is important to understand each in its correct context.

We know that most of the time we don't complete an entire IFR flight without some sort of intervention by a controller. During specific parts of the flight controllers may provide the pilot vectors. By definition vectors are a heading issued to aircraft to provide navigational guidance by radar. So, instead of the pilot providing his/her own navigation the controller (or ATC) is providing route guidance. It is prudent that the pilot always be aware of their current position, no matter if conducting their own navigation or being vectored. Vectors by controllers could take pilots *off their filed flight plan*. If a communications failure occurs, especially while off the filed flight plan, then this can become a major factor for confusion for the pilot trying to figure out what to do next. This is a primary difference for interpreting the guidelines above, whether the pilot is on the filed flight plan conducting their own navigation or is receiving navigational guidance per ATC. Let's use the following initial departure clearance as an example.

N9COF is cleared to Kilo Bravo Whiskey India (KBWI) as filed. On departure fly runway heading climb and maintain five thousand. Expect flight level 230 one zero minutes after departure. Departure frequency will be 125.25 squawk 2355 contact ground on 121.90 for engine start and taxi.

We know all IFR flights begin with an initial clearance provided by the clearance delivery controller. That is your *first clearance* of the flight. So, the first rule above (A.1.) is applicable from the start. If you notice (per A.4. above) the last part of the sentence also defaults to the filed flight plan just in a different context. If no other clearance were provided by a controller then your initial clearance (or the ATC approved flight plan) would apply for the entire flight. So your lateral navigation is "*cleared to Kilo Bravo Whiskey India (KBWI) as filed*" meaning you follow the path that you filed (this would include any fixes, airways, or standard departure and arrival routes).

In lieu of Standard Instrument Departure (SID) routes or Standard Terminal Arrival Routes (STARs) vectors are commonly provided just after takeoff to get the pilot headed to their initial route fix and thence, or during their arrival headed for the initial approach fix for a landing. So, *if communications fail while being vectored* the pilot upon realizing the failure proceeds direct to the fix, route or airway specified in the vector clearance (as per A.2. above).

For instance, the controller issues this instruction just before loss of communications, "*turn left heading 060 until reaching 6000 feet then proceed direct SANFI expect further clearance at 1330z.*" The pilot in this case has just taken off and is not yet on the filed flight plan route; SANFI is an intermediate fix before reaching the planned airway. When the pilot realizes that communications have failed s/he would proceed direct to SANFI. If reaching SANFI before 1330z then a holding pattern is entered over SANFI. The pilot would leave SANFI as close as possible to 1330z and proceed from that point to the next nearest fix (in this case the nearest fix on the airway to be used) on the filed flight plan and continue on the flight.

So, if your being radar vectored (navigation provided by ATC…and possibly off the filed flight plan) and realize a communications failure has occurred you proceed to the fix, route, or airway specified in the vector. From there you will always try to get to an assigned route (navigation provided by ATC…but possibly still not part of your flight plan), or route specified by an, expect further clearance (again navigation by ATC…possibly not part of the flight plan), or finally back to the filed flight plan (conducting your own navigation).

For instance, a controller issues this instruction, "*turn left heading 270 then direct to SANFI expect further clearance at 1950z*". The portion, "*turn left heading 270 then* *direct to SANFI"* is you're most recent approved clearance. There is another clearance pending and expected at 1950z. This most recent clearance doesn't replace your filed flight plan, it supplements it (be careful how you interpret the words in a clearance, it makes a difference!). When you complete all ATC provided instructions (supplemental), but haven't reached your destination, then its back to the filed flight plan (at least during a failure).

So, if a communications failure occurs after receiving this instruction then the pilot is to proceed direct to the SANFI fix as soon as the failure is realized (per A.2. above). If the pilot reaches SANFI before 1950z the aircraft must enter a standard holding pattern over the SANFI fix (*SANFI in this case is the clearance limit and you are not to proceed beyond it until 1950z*).

What is this, *expect further clearance* thing? Well, in the case above, it means the controller is planning on providing an approved clearance beyond SANFI intersection by not later than 1950z but the clearance is currently *pending* for one reason or another in the ATC system. *So in the case of a communications failure ATC will expect you to leave the SANFI intersection as close as possible to the, expect further clearance time of 1950z.* That is the ***PRIMARY*** reason for the time! In the absence of an assigned route, or route expected via a further clearance, the pilot always flies the approved filed flight plan (per A.4.), so as in the above case the pilot would leave SANFI for the next nearest fix on the filed flight plan.

So let's sum up these rules for lateral navigation of flights based on the examples given for use in a virtual environment.

If you're in IMC conditions and can not fly in VMC conditions then always fly (complete) the *last instructions* provided by your current controller first. Do not go beyond any *clearance limit* until reaching the, *expect further clearance time*. If a *further clearance route* is issued fly what was expected in the further clearance *from the last clearance given*. If you complete all instructions provided and *no other instructions are available* then proceed to the *next nearest point on the filed flight plan route* from your last fix and continue the flight. Remember that the approved filed flight plan at the start of the flight is the default when nothing else is available.

B. Altitude (Vertical Navigation). *At the highest of the following altitudes or flight levels for the route segment being flown*:
   1. The altitude or flight level assigned in the last ATC clearance received.
   2. The minimum altitude (converted, if appropriate, to minimum flight level) for IFR operations.
   3. The altitude or flight level ATC has advised may be expected in a further clearance.

Okay, you can see here that these rules are telling the pilot how to proceed on the route in regards to altitude, or the vertical navigation portion of the flight in conjunction with communications loss.

Of the 1.5 pages discussed in the AIM 6-4-1 *Two-Way Radio Communications Failure* almost an entire page is dedicated to the vertical navigation portion of the guidelines and most of that is examples.

There is a special note about communications failures while under IFR conditions that pertain specifically to vertical navigation. It states the intent of the rule is that a pilot who has experienced two-way radio failure (simulated here by the loss of the communications server) should select the appropriate altitude for the particular route segment being flown and make necessary altitude adjustments for subsequent route segments. If the pilot received an "expect further clearance" containing a higher altitude to expect at a specified time or fix, maintain the highest of the following altitudes until that time/fix:

4. The last assigned altitude; or
5. The minimum altitude/flight level for IFR operations.

Upon reaching the time/fix specified, the pilot should commence the climb/descent to the altitude advised to expect. If the radio failure occurs after the time/fix specified, the altitude to be expected is not applicable and the pilot should maintain an altitude consistent with 1 or 2 above. If the pilot receives an “expect further clearance” containing a lower altitude, the pilot should maintain the highest of 1 or 2 above until that time/fix specified in paragraph C “Leave Clearance Limit” described below.

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Example #1: A pilot experiencing communications failure at an assigned altitude of 7,000 feet is cleared along a direct route which will require a climb to a minimum IFR altitude of 9,000 feet, should climb to reach 9,000 feet at the time or place where it becomes necessary. Later while proceeding along an airway with an MEA of 5,000 feet, the pilot would descend to 7,000 feet (the last assigned altitude), because that altitude is higher than the MEA.

Example #2: A pilot experiencing communications failure while being progressively descended to lower altitudes to begin an approach is assigned 2,700 feet until crossing the VOR and then cleared for the approach. The minimum obstacle clearance altitude (MOCA) along the airway is 2,700 feet and the minimum en route altitude (MEA) is 4,000 feet. The aircraft is within 22nm of the VOR. The pilot should remain at 2,700 feet until crossing the VOR because that altitude is the minimum IFR altitude for the route segment being flown.

Example #3: The MEA between A and B is 5,000 feet. The MEA between B and C is 5,000 feet. The MEA between C and D is 11,000 feet. The MEA between D and E is 7,000 feet. A pilot had been cleared via A, B, C, D, to E (the lateral navigation clearance). While flying between A and B the assigned altitude was 6,000 feet and the pilot was told to expect a clearance to 8,000 feet at B. Prior to receiving the higher altitude assignment, the pilot experienced communications failure. The pilot would maintain 6,000 to B, and then climb to 8,000 feet (the altitude advised to expect). The pilot would maintain 8,000 feet, and then climb to 11,000 feet at C, or prior to C if necessary to comply with a minimum crossing altitude (MCA) at C. Upon reaching D, the pilot would descend to 8,000 feet (even though the MEA was 7,000 feet), as 8,000 feet was the highest of the altitude situations stated in this rule (B.1, 2, or 3).

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So again let me provide an example from the start of a flight. We will simulate a communications failure shortly after takeoff. We’ll use the following as our initial clearance.

N9COF is cleared to Kilo Bravo Whiskey India (KBWI) as filed. On departure fly runway heading climb and maintain five thousand. Expect flight level 230 one zero minutes after departure. Departure frequency will be 125.25 squawk 2355 contact ground on 121.90 for engine start and taxi.

You can see above (per B.1.) you are to maintain the altitude assigned in the last ATC clearance received. So if in your initial clearance you are told to climb to 5 thousand feet and you lost communications on takeoff you would be expected by ATC to climb to

5000 feet and stay there as long as one of the other requirements do not override the first one.

For instance, per B.2., if once you reach 5000 feet according to B.1. and on an upcoming route segment there is a minimum en route altitude (MEA) of 10,000 feet to clear a mountain range then you are expected to climb and reach 10,000 feet as required to meet the IFR operations over the mountain range, but let's not stop there, remember that you were told to expect further clearance to 23,000 feet after 10 minutes as would be the case in B.3. In that case 10 minutes after takeoff has passed you would be expected to leave either 5000 feet from your initial climb, or the 10,000 feet as per the MEA mentioned for the mountain range, depending where you are when the failure occurs and climb to 23,000 feet. That is the ***PRIMARY*** reason for the time!

If the 10,000 foot MEA were instead a minimum crossing altitude (MCA) then you would be required to start the climb so as to be at 10,000 feet before reaching the point indicated as the MCA. In other words, for the MEA the climb doesn't need to be started until reaching the route segment (the route segments starting waypoint) for 10,000 feet whereas if a MCA is applicable the climb must be initiated to reach 10,000 before reaching the route segments starting waypoint marked as an MCA.

So let's sum up these rules for vertical navigation of flights based on the examples given in a virtual environment.

Fly the last altitude clearance given or the altitude ATC has advised may be expected in a further clearance unless a greater IFR en route altitude is required for safe obstacle or terrain clearance. Maintain for cruise the highest of the three unless a greater IFR en route altitude is required.

Some are asking about now "*but that is for the flight itself, what about when I get to the destination, when do I start down?*" Well, now you know why pilots must always carry all the current maps and charts required for the flight conducted (*and that includes the alternate airport and approaches for it*). Using the appropriate low or high level en route maps, charts such as STARS (Standard Terminal Arrival Routes), or the approach charts for the destination airport the pilot will need to learn and recognize the minimum required safe altitudes they can descend to at given points. I discuss these in my instrument approach tutorials. Following your lateral navigation requirements use your charts and maps to determine minimum en route safe altitudes into the destination. When you reach the last altitude assigned by ATC maintain it until you must descend further for the landing.

When it comes to the landing itself ATC knows you need to land. The clearance to land is implied (like an emergency…not far from it here). In the real world they most likely would still be communicating to other aircraft around you and basically clearing a slot for you to conduct an approach based on your filed clearance. Just follow the charted approach and they will see which one you are probably conducting. Hopefully some means of communication has been restored to allow proper guidance before you get to your destination.

C. Leave Clearance Limit.

Okay, the last one, but if I write the real definitions to this one everyone is going to throw the book at me after what I just tried to explain. So I'll just explain this one per examples.

Please note that depending on the level of training provided to controllers of an ATC service they *may or may not* practice using clearance limits. This is because communications failures are rare for the most part so my explanation of them here is to ensure we cover all basic aspects of IFR flights you may run into virtually.

First, what is a "Clearance Limit"? The definition of a clearance limit is *the fix, point, or location to which an aircraft is cleared when issued an air traffic clearance.*

Also there is a definition for "expect further clearance time". *This is the time a pilot can expect to receive clearance to proceed beyond a clearance limit.*

So if a controller tells a pilot "*N9COF cleared to SPA VOR expect further clearance at 1950 Zulu*" the pilot can expect to receive another clearance that will allow him/her to proceed beyond SPA VOR by 1950z. In this case SPA VOR is the *clearance limit* and 1950z is the, *expect further clearance time*.

There are two types of clearance limits we are concerned with during loss of communications during an IFR flight. The first is whether the clearance limit is a fix *from which an approach begins* such as an Initial Approach Fix (IAF) as shown in figure 280.

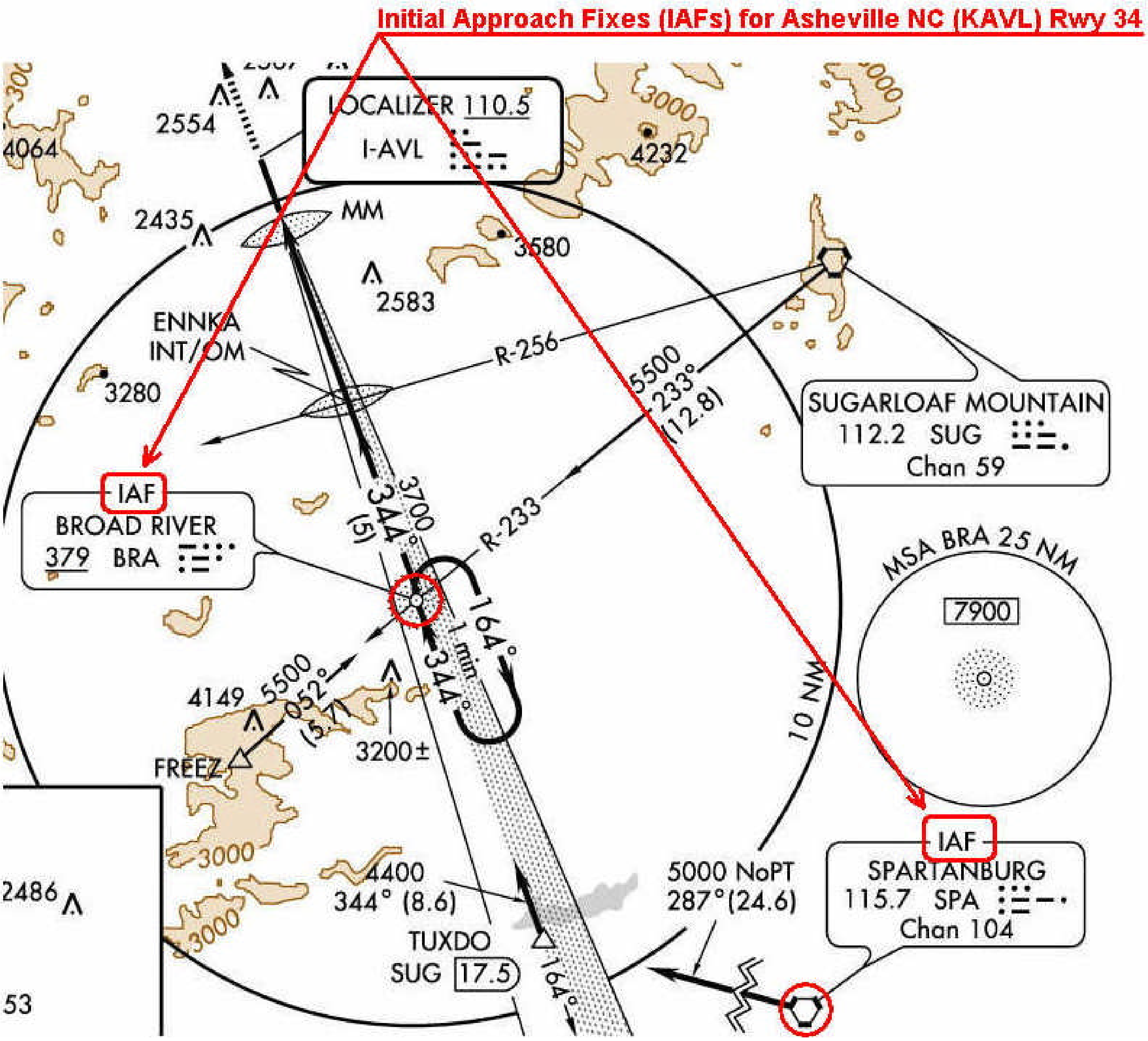


Figure 280 - Instrument approach chart showing initial approach fixes (IAFs).

Let’s make an example using figure 280 where *the clearance limit issued* ***is*** *an Initial Approach Fix (IAF)* say the Spartanburg VOR (identified as SPA). The clearance given by the controller might sound like this “N9COF cleared direct SPA, maintain 5000 feet and expect further clearance at 1950z”. If the pilot looses communications before reaching SPA (which will be before they receive a new clearance) and before 1950z then the pilot is required to hold at SPA at 5000 feet until 1950z. ATC will expect the pilot to leave the holding pattern as close to 1950z as possible and commence the descent or descent and approach as published.

If an expect further clearance time was ***not*** issued as part of the clearance, then there is a calculation involved based on the estimated time en route defined as *the estimated flying time from departure point to destination (liftoff to touchdown)* and the estimated time of arrival defined as *the time the flight is estimated to arrive at the gate (for scheduled operators) or the actual runway on times for nonscheduled operators.* Barring any amendments with ATC to the flight after departure if a pilot departed at 1700z with an estimated time en route of 3 hours and 5 minutes the estimated time of arrival would be 2005z. The pilot will be required to enter a holding pattern at the SPA VOR at 5000 feet until 2005z. ATC will expect the pilot to leave the SPA VOR as close as possible to 2005z and commence the descent or descent and approach.

The second is whether the clearance limit is ***not*** a fix *from which an approach begins* such as a fix along a route.

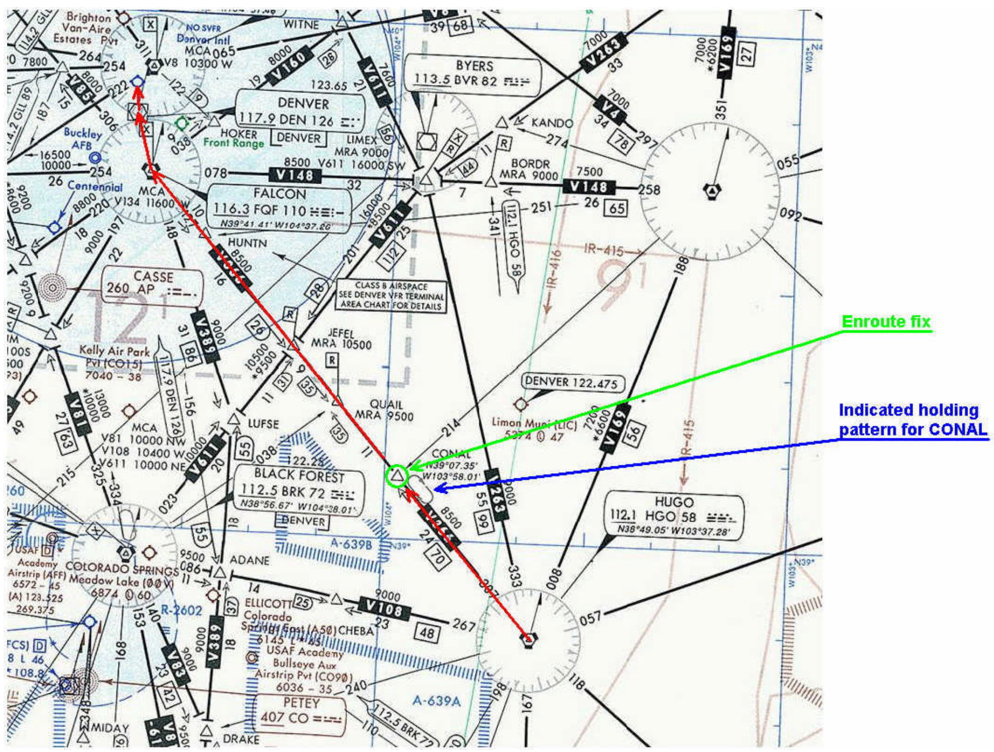


Figure 281 – En route fix CONAL.

Okay, let’s make an example using figure 281 where *the clearance limit issued is* ***not*** *an IAF,* say an intersection named CONAL. The clearance given by the controller might sound like this “*N9COF cleared direct CONAL maintain 9000 feet expect further clearance at 1950z*”. If the pilot looses communications before reaching CONAL (which will be before they receive a new clearance) and before 1950z then the pilot is required to hold at the CONAL intersection at 9000 feet until 1950z. *Note* in figure 281 that this fix has an indicated hold pattern which the pilot is expected to use. ATC will expect the pilot to leave the holding pattern as close to 1950z as possible and continue the flight as filed (in this case to Falcon VOR).

If an expect further clearance time was *not* issued as part of the clearance, then there is the same calculation involved as explained above with a slight twist. The 2005z time above was applied to the IAF at the destination airport which was the clearance limit in that case. In this case where the clearance limit is *not an IAF* the time (2005z) is the time *which the pilot should arrive at an IAF for the destination airport*. In other words, if the pilot arrives at CONAL (the clearance limit in this case) without an expect further clearance time and experiences a loss of communications, the pilot is to leave CONAL and proceed to an IAF from which the approach does begin and commence the descent or descent and approach as close as possible to 2005z.

Now we can summarize all this and come up with some "rules of thumb" for virtual pilots?

If…

The *clearance limit* ***is an IAF*** *for the destination airport* and an *expect further clearance time* is issued then the pilot *departs the clearance limit fix as close possible to the time issued*. If a time *was not issued* then the pilot calculates the estimated time of arrival and uses that time to *depart the clearance limit fix*.

But if…

The *clearance limit is* ***not an IAF*** *for the destination airport* and an *expect further clearance time* is issued then the pilot *departs the clearance limit fix as close possible to the time issued*. If a time *was not issued* then the pilot *departs the clearance limit fix on arrival trying to arrive as closely as possible at an IAF for the destination airport at the estimated time of arrival*.

Due to communications failures being rare many ATC services have pilots file flight plans, then fly the filed flight plans on their own navigation (*for the most part*), and vector the pilots where required such as right after takeoff and just before landing. The more in-depth an ATC service simulates the "real" thing, the more skills a pilot will require to be part of the activity just as real-life pilots must be well trained and certified. So lost communications skills may again be overkill, as most ATC services would rather stop the activity until repairs could be affected. It is a matter of choice…

SAFETY OF FLIGHT

In this section you'll learn a few things that are good to know during multiplayer activities and others that are items of interest to help you understand some of the things you may see or run across during your flight simulations. The things you need to ***absolutely*** take a look at here in this section is the information about altimeters, TCAS units (available in some complex modeled aircraft), and the notes about stepping away from the cockpit during multiplayer activities.

RUNWAY VISUAL RANGE (RVR)

Runway visual range is not simulated in flight simulator and is only included here so when you see it referenced on approach charts you'll understand what it is about. RVR values are measured by Transmissometers located along the runway on 14 foot towers spaced 250 feet apart, one tower being the projector and the other tower being the receiver.

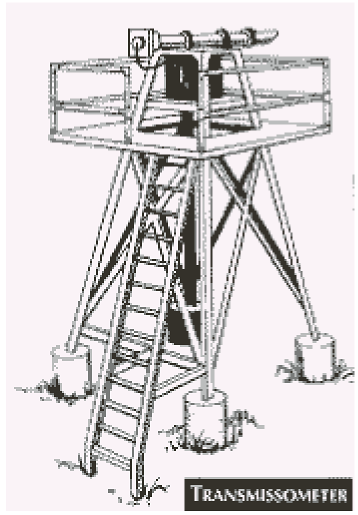


Figure 282 - Transmissometer.

A known intensity of light is emitted from the projector and is measured by the receiver. Any obscuring matter such as rain, snow, dust, fog, haze or smoke reduces the light intensity arriving at the receiver. The resultant intensity measurement is then converted to an RVR value by the signal data converter. These values are displayed by readout equipment in the associated air traffic facility and updated approximately once every minute for controller issuance to pilots.

The following table shows the approach categories with the corresponding minimum RVR values required for each.

CATEGORY	VISIBILITY (RVR)
NON-PRECISION	2400 FEET
CATEGORY I	1800 FEET
CATEGORY II	1200 FEET
CATEGORY IIIA	700 FEET
CATEGORY IIIB	150 FEET
CATEGORY IIIC	0 FEET

Figure 283 - AIM Table 7-1-5 Approach Category/Minimum RVR Table.

Basically RVR values are used to determine the minimums required to conduct a category I, II, or III ILS landing. In figure 283 you can see an RVR of 700 feet or better is required to conduct a CATIIIA approach. An RVR value of 600 feet or better is required to conduct a CATIIIB approach. The RVR value is not applicable to a CATIIIC approach because the CATIIIC can be conducted with zero visibility.

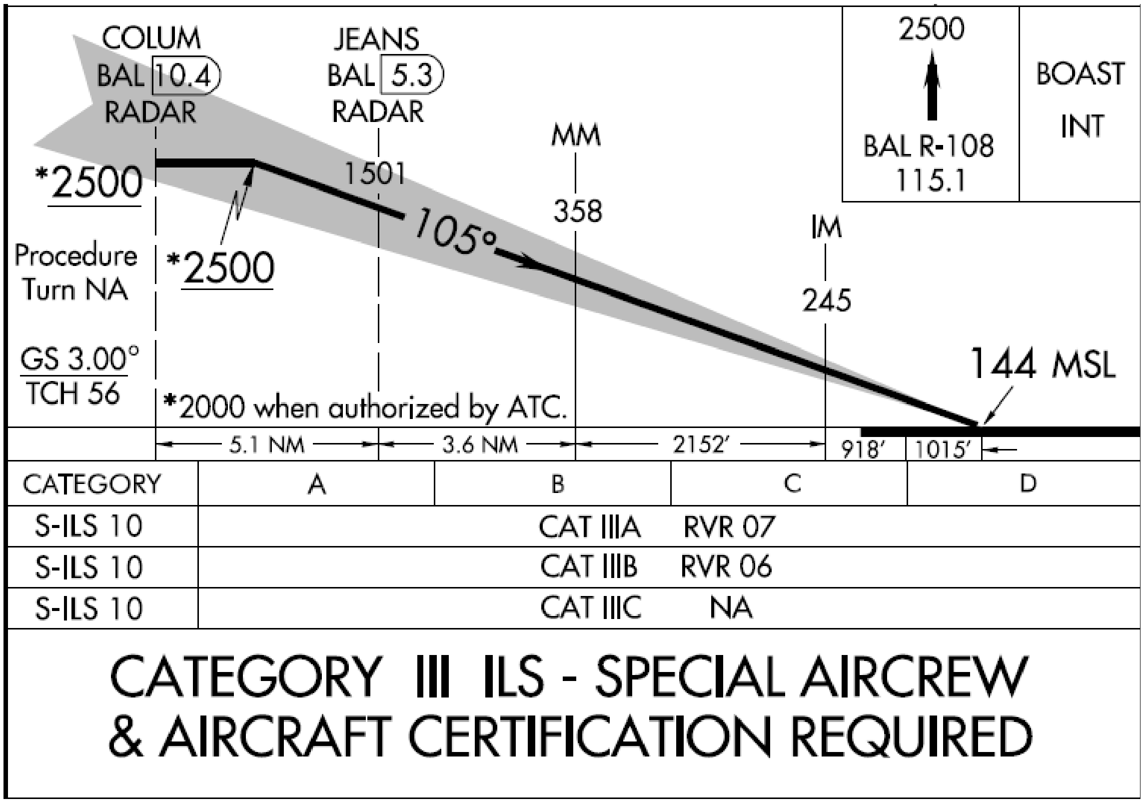


Figure 284 - KBWI RWY 10 CAT III minimums.

REPORTING VISIBILITY

Surface (horizontal) visibility is reported in METAR reports in terms of statute miles and increments thereof; example, 1/16, 1/8, 3/16, ¼, 5/16, 3/8, ½, 5/8, ¾, 7/8, 1, 1 1/8, etc. Visibility is determined through the ability to see and identify preselected and prominent objects at a known distance from the usual point of observation. Visibilities which are determined to be less than 7 miles, identify the obscuring atmospheric condition; example, fog, haze, smoke, etc. or combinations thereof.

Prevailing visibility is the greatest visibility equaled or exceeded throughout at least one half of the horizon circle, not necessarily contiguous. Segments of the horizon circle which may have a significantly different visibility may be reported in the remarks section of the weather report; example, the southeastern quadrant of the horizon circle may be determined to be 2 miles in mist while the remaining quadrants are determined to be 3 miles in mist.

REPORTING CLOUD HEIGHTS

Ceiling by definition in the CFRs and as used in aviation weather reports and forecasts, is the height above ground (or water) level of the lowest layer of clouds or obscuring phenomenon that is reported as "broken", "overcast", or "obscuration", example, an aerodrome forecast (TAF) which reads "BKN030" refers to height above ground level (AGL). An area forecast which reads "BKN030" indicates that the height is above mean sea level (MSL). Reference the AIM 7-1-30 *Key to Aerodrome Forecast (TAF) and Aviation Routine Weather Report (METAR)*.

Pilots usually report height values as MSL, since they determine heights by the altimeter. This is taken into account when disseminating and otherwise applying information received from pilots. ("Ceiling" heights are always above ground level.) In reports disseminated as PIREPs, height references are given the same as received from pilots, that is, above MSL.

PILOT WEATHER REPORTS (PIREPS)

FAA air traffic facilities are required to solicit PIREPs when the following conditions are reported or forecast; ceilings at or below 5000 feet; visibility at or below 5 miles (surface or aloft); thunderstorms and related phenomena; icing of light degree or greater; wind shear and reported or forecast volcanic ash clouds.

Pilots are urged to cooperate and promptly volunteer reports of these conditions and other atmospheric data such as: cloud bases, tops and layers; flight visibility; precipitation; visibility restrictions such as haze, smoke and dust; wind at altitude; and temperature aloft.

PIREPs should be given to the ground facility with which communications are established; example, the ARTCC. The ARTCC uses the reports to expedite the flow of en route traffic, to determine most favorable altitudes, and to issue hazardous weather information within the center's area.

All air traffic facilities and the National Weather Service (NWS) forward the reports received from pilots into the weather distribution system to assure the information is made available to all pilots and other interested parties.

ALTIMETERS

The aircraft altimeter is a marvelous piece of equipment. Used correctly it can provide a highly accurate reading for the pilot to maintain a safe altitude but the altimeter has unique operating properties subject to changes in temperature and pressures. These are operating traits a pilot must understand about altimeters or they can become an instrument of death. What are we talking about? Well, let's discuss some real-life aspects to obtain a general understanding of altimeters. Altimeters are normally a mechanical device which read atmospheric pressure. The accuracy of altimeters is affected by four general factors.

1. Nonstandard temperatures of the atmosphere.
2. Nonstandard atmospheric pressure.
3. Aircraft static pressure systems (position error)
4. Instrument error.

So, in the virtual world we will be subject primarily to the simulated properties of number 1 and 2. It is assumed 3 and 4 will be totally accurate in the modeled aircraft used for the flight. The administrators of the FSHost software *can change the first two properties on the weather settings page.* If the settings *are never changed* during a single session then the cautions I'll point out here are mute. If the host weather settings are changed periodically or are based on real-time real-world weather then the cautions are applicable.

So what cautions I'm I speaking of? Well if the settings are changed from high temperatures and pressures at the start of a flight and then set to extremely low temperatures and pressures toward the end of a flight then virtual pilots like real-life pilots need to exercise extreme caution when flying in proximity to obstructions or terrain if they *do NOT obtain a current altimeter reading*. This is especially true in *extremely cold temperatures*; this situation can cause serious errors that result in the aircraft being *significantly lower than the indicated altitude*.

There is a real-world motto associated with flying from a high to low pressure area which states "going from high to low look out below". In other words if the atmospheric pressure is dropping along the route of flight and the pilot disregards obtaining current barometric readings to properly set the altimeter the aircraft will eventually be lower than what is actually reported on the altimeter gauge. This of course is bad possibly exposing the aircraft to striking obstructions or terrain, hence the reason for receiving current barometric readings from each initial contact with a virtual controller when the aircraft is flying below 18,000 feet along the flight route.

Remember, every pilot flying at or above 18,000 feet dials in the standard sea level pressure of 29.92. Adoption of this standard altimeter setting at the higher altitudes eliminates station barometric errors, some altimeter instrument errors, and errors caused by altimeter settings derived from different geographical sources.

Pilots dial the barometric setting provided into the Kollsman window on the altimeter as seen in figure 285. The barometric pressure setting is a product of measuring atmospheric pressure via inches of mercury. *The Kollsman window is named for Paul Kollsman, who invented the first accurate altimeter*.

Figure 285 - Default Cessna 172 altimeter and the Kollsman window.

It is known that as altitude increases every 1000 feet that the measurement changes by one inch of mercury. For example, if you are at a sea level airport with an atmospheric pressure of 29.92 (standard sea level pressure barring pressure changes due to weather systems or temperature) if you climb 1000 feet the measurement would be 28.92. If you were to climb 2000 feet the measurement would be 27.92 and so on. Using this known standard it can also be said that *for every inch of error input into the Kollsman window you will get 1,000 feet of error in the altimeter reading*. So it is very critical for pilots to accurately input the altimeter reading as given, a 1,000 foot error while flying in a general aviation aircraft (due to the lower altitudes they operate at) over mountainous areas can really make ones day go bad.

For more information about altimeters reference the AIM 7-2-1 through 7-2-5 *Altimeter Setting Procedures,* which spell out many things about altimeters.

NOTES ABOUT STEPPING AWAY FROM THE COCKPIT

During an online ATC activity if the pilot steps away from the cockpit (due to physiological reasons, the girl or boy friend dropping by, or mom's home cooking <grin>) *the pilot must advise doing so* (there is a suggested format to "keep it real" and we'll discuss this later under the communications discussion in chapter 6). *Pilots should avoid lengthy absence from the cockpit* as the controllers may need to make sector handoffs (regularly done in-flight) or advise of traffic conflicts. If the controller feels that your extended absence may disrupt the activity (such as when approaching an airport for landing) *the controller can and most likely will terminate radar services and possibly even consider kicking you from the multiplayer server to prevent disruption of other flights* if required.

TCAS UNITS

Traffic Alert and Collision Avoidance System (TCAS) is a special device mounted in the cockpit and coupled to the transponder to provide an enhanced alerting system for collision avoidance.

Figure 286 - TCAS gauge built-in with the vertical speed indicator to provide RA (resolution advisories).

The TCAS gauge in figure 286 has buttons (the UP and DN buttons) to select the range that other air traffic will be displayed. The symbols for other aircraft on the gauge will change depending on the calculated course and altitude in reference to your aircraft, depicting the threat level of a conflict/collision if required. Some TCAS units provide a suggested evasive maneuver (resolution advisory) for a climb/descent to eliminate the conflict/collision calculated. *This resolution advisory will NOT provide lateral evasive maneuvers!*

AIM 4-4-15 Traffic Alert and Collision Avoidance System (TCAS I & II) reads as follows:

(a) TCAS I provides proximity warning only, to assist the pilot in the visual acquisition of intruder aircraft. No recommended avoidance maneuvers are provided nor authorized as a direct result of a TCAS I warning. It is intended for use by smaller commuter aircraft holding 10 to 30 passenger seats, and general aviation aircraft.

(b) TCAS II provides traffic advisories (TAs) and resolution advisories (RAs). Resolution advisories provide recommended maneuvers in a vertical direction (climb or descent only) to avoid conflicting traffic. Airline aircraft, and larger commuter and business aircraft holding 31 passenger seats or more, use TCAS II equipment.

1. Each pilot who deviates from an ATC clearance in response to a TCAS II RA shall notify ATC of that deviation as soon as practicable and expeditiously return to the current ATC clearance when the traffic conflict is resolved.
2. Deviations from rules, policies, or clearances should be kept to the minimum necessary to satisfy a TCAS II RA.
3. The serving IFR air traffic facility is not responsible to provide approved standard IFR separation to an aircraft after a TCAS II RA maneuver until one of the following conditions exist:
    a. The aircraft has returned to its assigned altitude and course.
    b. Alternate ATC instructions have been issued.

(c) TCAS does not alter or diminish the pilot’s basic authority and responsibility to ensure safe flight. *Since TCAS does not respond to aircraft which are not transponder equipped or aircraft with a transponder failure, TCAS alone does not ensure safe separation in every case.*

(d) At this time, no air traffic service or handling is predicated on the availability of TCAS equipment in the aircraft.

MULTIPLAYER VFR FLIGHT

CHAPTER 4

WHAT IS VFR?

It is visual flight rules defined as rules that govern the procedures for conducting flight under *visual conditions*. The term "VFR" is also used in the United States to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition it is used by pilots and controllers to indicate the type of flight plan.

So VFR is "…procedures for conducting flight under *visual conditions*". How do we define visual conditions? It is weather conditions equal to or better than the minimum for flight under visual flight rules. When used as an ATC clearance/instruction, the term may be abbreviated "VFR".

So our explanation brings us back to the visual flight rules and we need to explore some basics concerning these rules. Basic VFR weather minimums are described under section 91.155 of the FAR. There is a table that describes the many "flight visibility" and "distance from clouds" requirements for each type of airspace a VFR pilot may encounter. For virtual purposes, because weather simulation is not an exact science and because most pilots don't wish to get bogged down with remembering a table full of rules we need to form a basic rule for multiplayer activities that everyone can easily remember.

So let's break down the two primary components for VFR weather minimums, flight visibility and distance from clouds. In the table the majority of flight visibility requirements is 3 statute miles and has for the most part been the rule-of-thumb for real-life VFR pilots. Even at 3 miles this can be a challenge for the VFR pilot depending on other weather settings within FSHost.

Since the flight simulator doesn't reproduce a true 3D display (unless you have the necessary hardware and glasses to do this <grin>) then judging depth of field while flying is something we don't want to get involved with. So when it comes to "distance from clouds" the simplest answer is "clear of clouds". Basically virtual pilots need to stay away from any clouds either by flying below cloud decks, above a cloud deck or by weaving through "clear air" around clouds.

Rule 91.155 spells out the requirement for VFR weather minimums as, no person may operate an aircraft under VFR when the flight visibility is less, or at a distance from clouds that is less, than that prescribed… in our case here we will say …3 statue miles and clear of clouds and skip using the table.

So our rule talks about this 3 statue mile *visibility* but what is visibility? It is the ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent lighted objects by night. Visibility is reported as statute miles, hundreds of feet or meters.

It goes on to define some other visibilities we will encounter during our discussions in this manual.

Flight visibility is the average forward horizontal distance, from the cockpit of an aircraft in flight, at which prominent unlighted objects may be seen and identified by day and prominent lighted objects may be seen and identified by night.

Ground visibility is the prevailing horizontal visibility near the earth's surface as reported by… in our case it is the posted ATIS report or as advised by the controller.

So our rule now is very simple, if the FSHost weather is set below 3 miles visibility then VFR flights would not be allowed. All pilots would be required to fly by IFR rules but if the visibility is set exactly at 3 miles visibility or greater then pilots can conduct VFR or IFR flights. VFR flights would in this case need to remain clear of clouds. Now you have a better understanding of when VFR flight is possible during multiplayer activities.

FLIGHT DEVIATIONS FOR CLOUDS

I just mentioned that VFR pilots must remain "clear of clouds" also described as VMC (Visual Meteorological Conditions). Pilots are required to have an instrument rating to legally fly in IMC (Instrument Meteorological Conditions), in other words inside clouds, and must file an IFR flight plan when doing so. If a pilot does not have proper IFR training then safe control and navigation of the aircraft while in IMC conditions may not be possible, in other words, while inside of clouds the pilot may become spatially disorientated causing loss of control of the aircraft or not be able to properly navigate from one point to another.

When a VFR pilot is under positive ATC control, it is important for the pilot to advise the controller (typically in real-life sitting inside a building at a remote location) of any local weather conditions affecting the safe passage of their VFR aircraft. So, in our virtual world it is also prudent for the pilot to advise the controller of any required deviations around clouds which the controller can not "see" (clouds don't necessarily show up on radar, only elements of precipitation). The pilot should make timely calls to the controller requesting a climb, descent, left or right turn to avoid entering clouds that could disorient the pilot or create a dangerous situation due to unseen aircraft conflicts while under ATC control. Once the aircraft is clear of the clouds the pilot should advise the controller so normal ATC guidance can again resume. Typical calls to avoid clouds and weather might be as follows:

Example: Hickory Departure N9COF request 20 degree right turn for clouds.

Example: Atlanta Center N9COF request climb to 10000 feet for weather.

Example: Jacksonville Approach N9COF request descent to 4000 and 10 degree left turn to avoid weather.

Example: Baltimore Departure N9COF would like to level off at 3000 for 5 nautical miles before further descent for clouds.

There are many possibilities, be brief and to the point. The controller is obligated to provide the requested clearance for flight safety. The pilot is obligated to notify the controller as soon as possible about any required deviations and again when clear of clouds or weather so normal ATC control can resume.

A pilot is ultimately responsible for the safety of aircraft and passengers. If a pilot does not get clearance from the controller on a timely basis then the pilot is authorized to take whatever actions are required to avoid clouds and weather but ***MUST*** advise the controller as soon as possible as to what you are doing and why. Remember, a VFR pilot only needs to advise the controller when under positive ATC control. If not under positive ATC control such as when not inside controlled airspace the pilot is free to navigate around weather per VFR regulations.

PILOT INTENTIONS

In real-life a VFR pilot can literally takeoff from an uncontrolled airport and fly around all day and never need to talk with or contact ATC at all, but if the VFR pilot needs to, or will enter controlled airspace the requirement changes to mandatory. During online activities just as in the real-world VFR pilots that enter any controlled airspace need to contact ATC on the appropriate frequency to establish contact and state their intentions. During live activities pilots make initial contact with the controller labeled ATC1 in TeamSpeak. From then on the controllers will tell you which frequency (TeamSpeak channel) you should be on to receive ATC instructions until you are released from positive ATC control. If the VFR pilot has been released from positive ATC control and again needs to enter controlled airspace then the cycle starts again by the pilot contacting the controller labeled ATC1.

Pilot intentions can vary from requesting a takeoff at a controlled airport, requesting flight through the controlled airspace, or to actually approach a controlled airport to land. The following are some common pilot intentions used during VFR flights.

Taxi for Departure – The pilot intends to depart the airport either to stay in the local pattern or fly to another destination.

Taxi to Parking – The pilot intends to park the aircraft.

Transitioning – The pilot intends to travel through controlled airspace en route.

Full Stop Landing – The pilot intends to make a full landing, including taxi to parking.

Touch & Go(s) – The pilot intends to complete an approach, landing on the runway followed with an immediate take off. (The aircraft does not come to a stop.)

Low Approach(s) – The pilot intends to complete an approach and perform a runway flyby followed with an immediate departure. (The aircraft does not touch down.)

Visual Approach – The pilot intends to complete a visual approach, followed by either a low approach, or touch & go or full stop landing.

Closed Traffic – The pilot intends to remain in the airport traffic pattern to conduct successive operations involving takeoffs and landings or low approaches where the aircraft does not exit the traffic pattern.

VFR pilots training to become IFR pilots may request practice instrument approaches but must remain VFR (in VMC conditions) at all times.

ILS Approach – The pilot intends to complete an ILS instrument approach, followed by either a low approach, or touch & go or full stop landing.

VOR Approach – The pilot intends to complete a Variable Omni-range (VOR) approach, followed by either a low approach, or touch & go or full stop landing.

NDB Approach – The pilot intends to complete a Non-directional Beacon (NDB) approach, followed by either a low approach, or touch & go or full stop landing.

GPS Approach – The pilot intends to complete a Global Positioning System (GPS) approach, followed by either a low approach, or touch & go or full stop landing.

Proceed to Alternate – The pilot intends to proceed to an alternate airport due to weather or other reason that prevents landing at the destination airport.

VFR FLIGHT FROM AND TO CONTROLLED AIRPORTS

In the Chapter “Common Elements of Multiplayer Flight” I discussed how to determine if an airport is controlled or uncontrolled during multiplayer activities. Here, I’ll start with the scenario of flying VFR from and to controlled (towered) airports. Most online pilots tend to pick towered airports due to the length and size of runways and also the ATC interaction. Airports with towers are of course controlled including the surrounding airspace.

During *live* ATC activities the pilot can expect all towered airports to be active, so it is mandatory to establish contact with ATC to obtain permission to move within that airspace (whether on the ground or in the air). The VFR pilot much like the IFR pilot must get permission to takeoff and land at towered airports. There are subtle differences such as the IFR pilot having to obtain an IFR clearance. The VFR pilot can literally climb into the aircraft, fire it up, contact the ground controller to taxi to the active, switch to tower to get a takeoff clearance, and away they go. Like the "weekend" pilots do for those Sunday outings wandering around the country side.

Keep in mind that pilot/controller communications involved with these scenarios will be discussed in detail in a following chapter. Here you should focus on what to expect and the sequence of events for specific actions to properly conduct VFR flights around towered airports. Communications examples are provided where needed for clarity of concepts.

DEPARTING VFR FROM A CONTROLLED AIRPORT

You have just sit down and connected to the multiplayer server to join in on the latest activity. You decide that today you wish to takeoff from Asheville Airport (KAVL) VFR to fly to Charlotte Douglas International (KCLT) to meet some friends (simulated of course <grin>). So before cranking up the engine get the weather (check the FSHost weather) and make sure the visibility is 3 statue miles or better. Remember that is the minimum required to fly VFR.

Also decide if you are going to file a VFR flight plan? VFR flight plans are not mandatory for VFR flight but as in real-life are highly encouraged. They act as an insurance policy that someone will come looking for you if you don't return home or don't reach your destination. In the virtual world they serve as a tool to practice filing appropriate flight plans. This will make you more proficient with them when you must file IFR flight plans. Your VFR flight plan will also help the online controller's situational awareness because they will know, for the most part, where you intend to go. If you later change your mind in-flight then call the ATC1 controller addressing them as Flight Service and request they change your plan or just cancel it altogether. The main thing is once you file a flight plan stick to it! Flight plans are filed after you have connected to the multiplayer server by pressing ENTER on your keyboard which will open the multiplayer chat window. Then following the rules for filing flight plans as discussed in chapter 3 "Common Elements of Multiplayer Flight".

So the weather is within proper limits for VFR flight and the flight plan is filed. Now call the ground controller on TeamSpeak labeled ATC1 addressing them as Asheville Ground Control and request permission to start engines and advise them you will be departing east VFR for KCLT. Note here that the VFR pilot is not expected to contact the ATC1 controller as Asheville Clearance Delivery as is expected for IFR pilots. In real-life Clearance Delivery controllers are normally available at busy airports to provide departing IFR aircraft clearances on a separate frequency than ground (due to the high volume of communications traffic that may interfere with ground control operations) whereas at smaller and less busy controlled airports the ground controller would provide these without any problems. So during virtual operations, as a standard, contact the ATC1 controller as ground control if departing VFR, whereas if you will depart IFR, contact them as clearance delivery.

If you have an ATIS identifier (ATIS stands for Automatic Terminal Information Service) typically posted on the TeamSpeak server in the ATC1 frequency (channel) description block, then tell the ground controller the identifier so they can skip reading you the weather you just obtained (the controller will read the weather if you don't advise them you obtained it via the ATIS ID). The ground controller will grant you permission to start your engines and advise you to call back when ready to taxi.

Once you're ready to taxi call the ground controller again for your taxi clearance. Note that when departing a controlled airport in real-life the pilot will normally be given a squawk code to transmit after airborne. Some online ATC services have the software to properly simulate this but others don't

(FSHost does not simulate squawk codes) so this may or may not be something you must pay attention to. Consult the operational guidelines for the ATC service you use. The ground controller will provide you taxi instructions (keep pencil and paper ready to copy any instructions). The controller may rattle off several specific taxiway identifiers for you to follow so writing them down will help you remember them. Real-life pilots typically have some sort of kneeboard or clip board available to hold a paper pad for notes or required charts and maps while in flight.

Most flight simulator airports use taxiway signs and markings to allow the pilot to properly taxi to or from the active runway. The pilot should be able to see these outside the cockpit window while taxiing. If you don't see taxiway signs or markings, are unfamiliar with the airport, or lack the proper airport diagram to get around then just request a "progressive taxi" and the controller will stay with you and provide step-by-step instructions all the way to the runway. If on the way to the active runway you are required to cross another runway, ***DO NOT*** unless/until cleared by the ground controller. So if the ground controller doesn't clear you as you approach a runway ***STOP*** at the proper hold short line (see figure 287) and ask for a crossing clearance. Chances are the controller will clear you as you approach the intersection but if not ***STOP***. Once cleared continue your taxi as required until reaching the runway where typically you will have been instructed to hold short and contact tower. The ground controller may tell you to monitor the tower frequency before reaching the active runway. What this means is that there probably isn't any other intersections between you and the hold short point. So the ground controller can be fairly confident you won't have any possible traffic conflicts before reaching the hold short point. So tune into the tower frequency and monitor it while completing your taxi to the active runway. Once you reach the hold short point ***STOP*** and take care of any last minute checklist items before contacting the tower controller.

There are hold short lines that set various restrictions on pilots. There could be more than one hold short line. Let me briefly show you the typical hold short points.

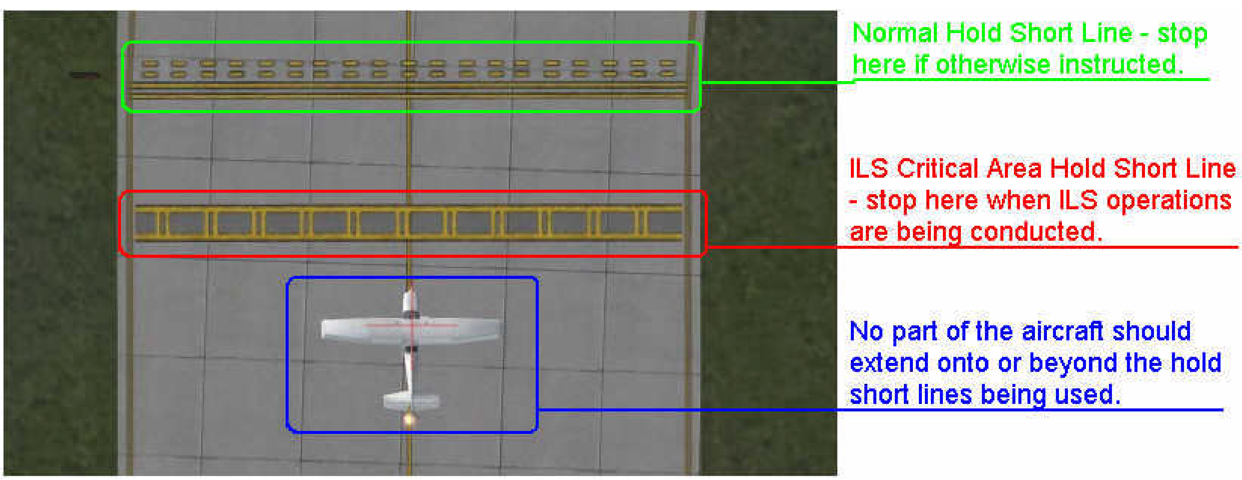


Figure 287 - Hold short lines.

In figure 287 above the hold short line circled in green is the line typically used if not advised otherwise by the controller. If an IFR landing operation is being conducted by another aircraft then the ground controller may advise "…hold short at the ILS line" (circled in red above). This is to prevent interference with the ILS radio signal beams the landing aircraft receives for guidance to reach the landing threshold. The ILS hold short point will keep the aircraft further back from the runway outside the ILS critical area. The AIM clearly states that pilots should not let any part of the aircraft extend onto or beyond these lines for the operation used unless a proper clearance is provided. If a landing aircraft is clearing the runway then the aircraft is not considered clear of the runway until all of the aircraft is beyond the proper hold short line, in this case coming off the runway versus to get on the runway. Typically there will be signs along side the taxiway at these lines that also help identify these hold short points (reference the section about Taxiway/Runway signs and markings in the chapter "Common Elements of Multiplayer Flight").

Most small single or twin engine aircraft will do their engine "run up" at the hold short point (or before depending on the airport operations). It is also the point where most pilots turn on their landing lights, strobe lights, activate the transponder with altitude reporting if applicable, and other last minute items. If you're at a busy airport or departing aircraft are backed up, it is best to have these items completed before reaching the hold short line (done while taxiing) so as not to further delay departures. When ready for takeoff contact the tower controller and advise them. The tower controller will typically provide the pilot a final wind direction and speed and clear the pilot for takeoff.

Once airborne the VFR pilot will be vectored to an initial heading to get you started in the right direction (remember you told the ground controller you would be departing KAVL east VFR for KCLT). The tower controller will hand off the pilot to the airport departure controller at an appropriate distance and/or altitude and the departure controller will follow the aircraft to the extent of their boundary. At that time the departure controller will release the VFR pilot from all ATC control by stating "N9COF you are departing my area of control, squawk 1200 and maintain own VFR separation, radar services terminated have a good flight." From here the VFR pilot is again in charge of their flight responsible for proper VFR separation from other aircraft/weather and completes the flight on their own or until again entering controlled airspace. In other words, you are free to change your altitude and direction of flight per VFR rules as you wish and while staying clear of clouds (and hence stay within VFR conditions) and continue to fly your intended route of flight. Don't forget to fly at altitudes as required by VFR pilots, odd plus 500 when flying any course between 0 and 179 degrees or even plus 500 when flying any course between 180 and 359 degrees as previously discussed.

If you must transition through controlled airspace along your intended route of flight do not forget to contact the appropriate controller (ATC1 on TeamSpeak) to get permission to enter the controlled airspace and pass through it. Tell the controller WHO you are, WHERE you are, and WHAT your intentions are BEFORE reaching the airspace to be passed through. You must get permission BEFORE entering the airspace or either hold or divert around it via uncontrolled airspace until you do.

ARRIVING VFR AT A CONTROLLED AIRPORT

As mentioned a typical VFR flight can be conducted without any ATC contact or without being under ATC control but if a pilot's destination airport is a controlled airport they must first establish contact with ATC at the airport to enter the airport's airspace and land. No pilot should ever penetrate controlled airspace or attempt to land at a controlled airport without first being in contact with the appropriate air traffic controller, stating their intentions and being properly identified on radar (unless maybe an emergency exists).

So in the case of a multiplayer activity the virtual VFR pilot must then enter the channel with the controller labeled ATC1 to establish contact (always make initial contact through this controller). The pilot might state their intentions like this "Charlotte Approach Cessna N9COF with you approximately 50 miles to the west at 7500 landing Charlotte." This tells the controller labeled as ATC1 WHO you are, WHERE you are, and WHAT your intentions are, that you wish to be sequenced to land at KCLT.

In real-life the pilot is normally squawking 1200 (the code for a VFR flight) with their onboard transponder (if so equipped) and the Charlotte Approach Controller would at this time assign a unique squawk code for the pilot to dial into the transponder to aid proper identification on the radar screen while within the controlled airspace. To further aid in this identification the real-life controller will typically tell the pilot to "ident" which tells the pilot to push a button on the transponder panel that will cause the blip for their aircraft to light up very bright on the radar screen which makes it easy for the controller to identify the aircraft. If a transponder isn't available to aid identification then the controller might have the pilot make a specific turn and watch for this turn on the radar screen at the location indicated by the pilot. In our virtual world identification can be done by a squawk code if the software allows this or simply by locating the aircraft identification, in this case N9COF, via FS Navigator.

In our case, since FSHost doesn't provide for proper squawk code simulation the controller verbally simulates assigning a squawk code and tells the pilot to ident. The pilot confirms squawking the proper code and pressing the ident button. The controller will then after a short pause tell the pilot something like this "N9COF Charlotte Approach radar contact, altimeter 29.52, descend and maintain 5000 feet and turn heading 270 degrees you can expect the visual for runway 5." The pilot is now under positive control by the Charlotte Approach controller (the controller labeled ATC1) and the pilot is expected to follow any instructions issued by the controller while within the controlled airspace. From here the controller will vector the pilot for the visual approach and eventually hand off the pilot to the tower controller for final landing clearance.

VFR FLIGHT FROM AND TO UNCONTROLLED AIRPORTS

Airports without towers are of course uncontrolled airports. In the real-world uncontrolled airports are usually managed by an airport FBO (Fixed Base Operator). Even though no control tower is present the FBO usually has an office that typically has a base radio for communications with local air traffic and basic weather instrumentation. Many such airports may have an ATIS broadcast available on a specific frequency providing automated weather reports describing conditions at the airport. The FBO will typically advise (relay information) to departing and arriving pilots of any other air traffic reporting in the area and current airfield weather conditions if an ATIS is not available.

There are specific rules that pilots must follow concerning communications to report their movements either on the ground or in the air either when departing or arriving at an uncontrolled airport. This helps other pilots paint a mental image of your current location, where you are going, your altitude, and your intentions (again the WHO, WHERE, and WHAT). These reports are made by specific announcements on your aircraft radio "in the blind", in other words you make the calls regardless if anyone answers you. Depending on your report another aircraft may talk to you to coordinate movements of their aircraft and yours if they are using the same airport. This keeps your situational awareness up to speed on anything moving in your area and at the airport you intend to use either on the ground or in the air. Remember, the VFR pilot is ultimately responsible for proper separation from other aircraft (and weather) when not under positive ATC control.

During multiplayer activities the ATC service should provide a single channel to simulate a CTAF or UNICOM frequency used at uncontrolled airports. At the same points in time that a real-life VFR (or IFR) pilot would be required to tune into this frequency to make reports the same goes for the multiplayer pilot. I'll discuss here what these points are for the VFR pilot either departing or arriving at uncontrolled airports. Even though it may feel "odd" making such reports in the blind on a TeamSpeak channel during live ATC activities this is not unlike the real-world pilot. If there is enough participation during a live ATC activity you may actually hear another pilot (maybe at another airport) making similar calls for departing or landing there, or it may be at the airport you are using. If so communicate to the other pilot your intentions and coordinate your actions accordingly.

Again, keep in mind that pilot/controller communications involved with these scenarios will be discussed in detail in a following chapter. Here you should focus on what to expect and the sequence of events for specific actions to properly conduct VFR flights around non-towered airports. Communications examples are provided where needed for clarity of concepts.

DEPARTING VFR FROM AN UNCONTROLLED AIRPORT

VFR flight from an uncontrolled airport has only a few minor differences compared to VFR flight from a controlled airport. If a pilot decides to depart from an uncontrolled airport the first decision is again whether to file a VFR flight plan. This decision is usually based on whether the pilot intends to fly an extended cross country flight or if the flight will be in the local area. Pilots flying cross country are encouraged to file a VFR flight plan as "insurance". In real life pilots file VFR flight plans so if they do not arrive at the destination as expected a search will be conducted to locate aircraft and pilot. During multiplayer activities it is merely a good way to practice filing correct flight plans. Again filing a VFR flight plan is a pilot preference. If filing a flight plan enter the VFR flight plan per instructions in the section "Flight Plans" described in chapter 3 "Common Elements of Multiplayer Flight".

Since an uncontrolled airport doesn't have a control tower the pilot now becomes entirely responsible for the safe operation of the aircraft on the ground during taxi, takeoff, and while departing the airport area. So let's depart an uncontrolled airport.

As briefly mentioned radio calls at uncontrolled airports are conducted during live ATC activities on a channel provided on the TeamSpeak server. Since this channel is used for any airport globally it is necessary for the pilot to always include the airport name in the calls so other pilots will know if you are at the airport where they are. Remember, the intent is to draw a mental picture for others to understand WHO you are, WHERE you are, and WHAT your intentions are.

Start your engine. The first call will be BEFORE moving the aircraft from the parking spot (before taxi). The pilot announces ready for taxi as follows:

Example: Wilkes County Unicom N9COF will taxi to runway 19 for a southwest departure.

Now you can move the aircraft from parking and proceed to the active runway. At smaller uncontrolled airports it is not unusual for a pilot to have to "back taxi" to the end of a runway. This is because smaller airports don't have the additional taxiways to the end of a runway.

Figure 288 - Uncontrolled airport taxiways.

In figure 288 taxi routes A and B (shown in red) show taxiways to the end of each runway. This allows a pilot to safely taxi to the runway takeoff point without actually being on the runway (but it costs more to build these). Some smaller uncontrolled airports do not have these taxiways available but instead require the pilot to taxi from the parking area to a runway midpoint such as in taxi routes depicted by C or D (shown in yellow). This requires the pilot to get on the active runway to "back taxi" and reach the takeoff point. In such cases the pilot must exercise extreme caution for other departing or landing aircraft that will be using the runway.

So the next mandatory call can go two ways depending on the type of taxiways available to you. If the airport has a taxiway to the end of the runway (as in taxiways A or B) the pilot holds short of the runway and makes the following call.

Example: Wilkes County Unicom N9COF holding short of runway 19 ready for departure.

If the airport does not have taxiways to the end of the runway (as in taxiways C or D) and will require the pilot to back taxi then the pilot again will hold short of the runway and make the following announcement:

Example: Wilkes County Unicom N9COF holding short ready for back taxi to runway 19 for departure.

NOW LISTEN! Give a brief moment for another pilot to announce possibly arriving for landing at the airport BEFORE you take to the runway. While listening to the radio the pilot should check both ends of the runway either for aircraft departing or arriving for landing. When satisfied that no other aircraft are currently on the runway (after landing or preparing to depart) or landing from either direction the pilot can taxi onto the runway (or back taxi) and position for takeoff. BEWARE, even if you didn't hear anything always keep your eyes outside the cockpit looking around. What if a pilot were landing with a radio inoperative? Anything can happen, be alert!

The next call is to announce taking off from the runway as follows:

Example: Wilkes County Unicom N9COF taking off runway 19.

After taking off from the runway the next call is to announce clear of the runway, altitude and direction of departure as follows:

Example: Wilkes County Unicom N9COF clear of runway 19 climbing through 1000 feet for 5000 departing to the southwest.

The pilot should continue to monitor the Unicom frequency until clear of the airport area (3000 feet AGL and 5 nautical miles) at which time the pilot can switch frequencies as required.

Note that if the pilot filed a VFR flight plan on the ground before departure the pilot will need to activate the flight plan with the appropriate flight service center (in a multiplayer activity you can simulate this by calling the controller labeled ATC1 addressing them as flight service and requesting they activate your VFR flight plan).

Example: Flight Service N9COF off at Wilkes County request activation of VFR flight plan.

The controller will simulate activating the flight plan by looking up the flight plan you filed in FSHost (just as they would do with an IFR pilot) and call you back if everything is okay and confirm your flight plan is active.

The controller will respond as follows:

Example: N9COF Flight Service VFR flight plan activated.

If you did not file a VFR flight plan the flight continues normally at this time regardless.

ARRIVING VFR AT AN UNCONTROLLED AIRPORT

Unlike arriving at a controlled airport where the pilot must obtain permission to enter the controlled airspace things are different at the uncontrolled airport because there is typically no local ATC service such as an approach, tower, or ground controller to assist in safe aircraft movement and sequencing. *Again the pilot assumes full responsibility for safe operation of their aircraft and providing the necessary radio calls* ***in the blind*** *on the assigned TeamSpeak channel to make other pilots aware of their movements and intentions.*

When the pilot is approximately 30 to 40 nautical miles from the destination airport the pilot makes the first call to announce their intentions to land as follows:

Example: Wilkes County Unicom N9COF at 5000 feet 30 nautical miles to the southwest landing full stop.

This call makes other pilots aware of WHO you are (N9COF), WHERE you are (30nm out at 5000 feet approaching from the southwest), and WHAT your intentions are (to make a full stop landing). Typically at this point in real-life the FBO (Fixed Base Operator) at the airport would call you (because they heard you are approaching to land) and provide you with the current wind direction/speed and the current barometric reading (if an ATIS broadcast is not available). They may also advise you if any other aircraft are in the area. The FBO is not a controller and doesn't have radar to see air traffic; they only relay information about what reports they have heard on the radio. During online multiplayer activities you won't get a call from the FBO so you will need to obtain the wind direction/speed from the FSHost server to determine the runway you will use to land on (please land into the wind ☺).

Depending on the direction you arrive from you may be required to enter the airport traffic pattern in a particular manner. Reference the section about airport traffic patterns in chapter 3 "Common Elements of Multiplayer Flight" about how airport traffic patterns work so you can be prepared to enter and navigate the traffic pattern properly. Provide a call in the blind for each part of the traffic pattern you enter such as the downwind leg, base leg, and then the final.

Example: Wilkes County Unicom N9COF entering a left downwind for runway 1.

Once you are on final approach for the runway (within approximately 5 nautical miles of the threshold) the pilot makes the next call as follows:

Example: Wilkes County Unicom N9COF on final for runway 1 full stop landing.

Even though the pilot may not hear any calls from other pilots they must be alert for other airborne traffic in the area or aircraft on the runway landing or taking off. Stay very vigilant of your surroundings by looking *outside* the cockpit and what you hear on the radio. As you approach the runway look around the airport traffic pattern for other aircraft preparing to land then look at the runway closely for aircraft that may have just landed or aircraft preparing to depart. If the runway is clear and there is no traffic conflicts land your aircraft. Remember, an aircraft may be *anywhere* (do not trust that other pilots are following proper traffic rules), also the other aircraft may not have an operable radio for one reason or another! Don't presume you will always hear them on the radio.

Once on the ground and clear of the runway the pilot makes the final call as follows:

Example: Wilkes County Unicom N9COF clear of runway and taxiing to parking.

This tells other pilots you have cleared the runway and your intentions to taxi to parking.

After parking the aircraft the pilot is responsible to cancel any open VFR flight plan. This is done in the multiplayer activity by opening the multiplayer chat window and typing in –fp. This command tells FSHost to close your flight plan. This simulates calling Flight Service on the telephone from an uncontrolled airport to cancel the flight plan. The pilot can also simulate closing the VFR flight plan BEFORE landing by calling the controller labeled ATC1, addressing them as Flight Service and requesting the VFR flight plan be closed.

VFR FLIGHT FOLLOWING

Flight following is nothing more than traffic advisories defined as advisories issued to alert pilots to other known or observed air traffic which may be in such proximity to the position or intended route of flight of their aircraft to warrant their attention. A typical traffic alert would be worded like "Traffic, 2 o'clock, one zero miles, southbound, at eight thousand." Traffic advisory service (or flight following) will be provided to the extent possible depending on higher priority duties of the controller or other limitations; e.g., radar limitations, volume of traffic, frequency congestion, or controller workload. These traffic advisories *do* ***not*** relieve the VFR pilot of their responsibility to see and avoid other aircraft and the pilot should not assume that all traffic will be issued.

A brief note about TCAS here, TCAS (Traffic Collision Avoidance System) provides similar information to the pilot if the aircraft is equipped with such a unit; they work primarily between/via transponder equipped aircraft. TCAS instruments provide information to a pilot about nearby aircraft and immediate traffic conflicts just as a controller that provides flight following. Depending on the type of TCAS it may even provide the required maneuvers (only climbs or descents) required to avoid collisions (called resolution advisories or RA).

Also let me emphasize flight following is not positive ATC control meaning the pilot is free to navigate VFR at their discretion within uncontrolled airspace. If the VFR pilot makes a 180 degree turn, a 360 degree turn, climbs 5000 feet up, descends 3000 feet down, does a loop, or any other maneuver the controller doesn't care. The controller's responsibility is to advise the pilot of any other nearby aircraft and possible conflicts while flight following is provided.

Flight following is a tool for traffic separation only. It is important to understand this difference because the controller does not provide instructions for routing or sequencing, only traffic advisories. Pilots are not receiving instructions for lateral or vertical guidance which must be followed as when under positive ATC control such as an IFR pilot receives. Example, w*hen departing controlled airports positive ATC control typically ends when the departure controller releases the VFR pilot by stating "radar services terminated". At that time the pilot is on their own to conduct navigation and altitude changes as required. When approaching a controlled airport positive ATC control typically begins when the VFR pilot requests permission to enter controlled airspace to land at a controlled airport and after being provided a unique squawk code for the transponder and hearing the controller respond with "…radar contact…." At that time the pilot is under positive ATC control and is required to follow the controller's instructions.*

During multiplayer activities VFR flight following is typically requested just after takeoff from an airport (controlled or uncontrolled). If departing a controlled airport the departure controller will hand off the pilot as appropriate to a center controller to receive flight following services until the services are terminated. If departing an uncontrolled airport the pilot contacts the controller labeled ATC1 on TeamSpeak addressing them as "Center" and advising them who they are, where they are, and the request to receive flight following services. The controller will properly identify the aircraft and start the services. This may be done at the same time the VFR pilot requests the controller to activate the VFR flight plan. Note that in our previous discussion the pilot normally addresses the ATC1 controller as "Flight Service" to activate the VFR flight plan. In this case when departing an uncontrolled airport when the pilot will not only need to activate the VFR flight plan and request flight following at the same time the ATC1 controller can be addressed as a "Center" controller who can take care of both requests.

If a VFR pilot did not initially request flight following after departure and has already had their ATC service terminated but now wishes to start flight following then no problem. Enter the channel labeled ATC1 and contact the controller addressing them as "Center". From there the ATC1 controller will provide air traffic advisories and hand off the pilot to subsequent controllers along the route as required.

The controllers will continue to provide traffic advisories until either the pilot cancels flight following or the controller cancels the service due to one of the reasons stated earlier.

It should be noted that if a pilot is receiving traffic advisories (flight following) at the time they contact an approach controller when preparing to enter controlled airspace at an airport to land, approximately 50 to 60 miles from the airport, the pilot would contact the center controller providing the flight following service advising the controller of their approach into the destination airport and their wish to cancel the traffic advisories. Remember, the controller providing flight following may or may not know of your flight route or intentions depending on whether you filed a VFR flight plan, they are only providing traffic advisories (not monitoring your route of flight like might be done for an IFR pilot) so you must advise them of your needs. Once the controller is advised that you wish to cancel flight following the controller will terminate your flight following service and advise you to contact approach control at KCLT.

In practical terms, during a multiplayer activity, the virtual skies would have to be pretty crowded to really see any good use for flight following but still it is great to simulate and practice. It provides another facet of air traffic control for controllers and pilots.

MANDATORY RADIO CALLS

This is a summary of the mandatory radio calls required at uncontrolled airports on the appropriately assigned TeamSpeak channel.

If departing an uncontrolled airport:

Wilkes County Unicom N9COF will taxi to runway 19 for a southwest departure.
Wilkes County Unicom N9COF holding short of runway 19 ready for departure.
Or
Wilkes County Unicom N9COF holding short ready for back taxi to runway 19 for departure.
Wilkes County Unicom N9COF taking off runway 19.
Wilkes County Unicom N9COF clear of runway 19 climbing through 1000 feet for 5000 departing to the southwest.

If arriving at an uncontrolled airport.

Wilkes County Unicom N9COF at 5000 feet 30 nautical miles to the southwest landing full stop.
Wilkes County Unicom N9COF entering left base runway 1 full stop. (include other legs as appropriate!)
Wilkes County Unicom N9COF on final for runway 1 full stop.
Wilkes County Unicom N9COF clear of runway and taxiing to parking.

VFR MISSED APPROACHES

Missed approaches at controlled airports during VFR landings are uncomplicated. If you botch a landing then declare the missed approach to the tower controller and your next intentions (try the landing again or leave the airport area) as follows:

Example: Hickory Tower N9COF missed approach would like vectors to try again.
Or
Example: Hickory Tower N9COF missed approach would like to depart to the north.

The tower controller will provide instructions as requested.

Missed approaches at uncontrolled airports during VFR landings are quite simple also. If you botch a landing then announce it on the Unicom frequency as follows:

Example: Wilkes County Unicom N9COF missed approach runway 1 climbing to 3000 feet entering left downwind for runway 1.

In the above example the pilot climbs to the airport traffic pattern altitude (usually 1000' AGL at any airport) and enters a left downwind to runway 1 to try again. For more about airport traffic patterns reference the section "Airport Traffic Patterns" in the chapter 3 "Common Elements of Multiplayer Flight".

Or

Example: Wilkes County Unicom N9COF missed approach runway 1 climbing to 3000 feet departing to the south.

MULTIPLAYER IFR FLIGHT

CHAPTER 5

WHAT IS IFR?

By definition it is rules governing the procedures for conducting instrument flight. Also it is a term used by pilots and controllers to indicate the type of flight plan. Instrument flight is flight conducted under instrument meteorological conditions (IMC) which by definition is meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling less than the minima specified for visual meteorological conditions (VMC).

In a nutshell, when virtual IFR pilots file a flight plan and fly under instrument flight rules they are under ATC control from the time they start engines at the departure airport until they shutdown engines at their destination. Air Traffic Control by definition is a service operated by appropriate authority to promote the safe, orderly and expeditious flow of air traffic. To further explain, ATC is responsible for the safe separation and sequencing of aircraft during IFR flights using modern radar technology which is also available for VFR flight following (just discussed). IFR pilots typically are under IMC conditions that limit their ability to maintain visual separation from other aircraft while on the ground or in flight due to poor visibilities. Also, modern jet aircraft travel at high speeds that necessitate the ability for advanced warnings of air traffic conflicts. Under the watchful eyes of a controller using modern radar technology air traffic can be monitored, sorted, and sequenced to affect safe, orderly, and expeditious flow.

Pilots that are instrument rated are not prohibited from flying in weather conditions that would otherwise ground the VFR pilot. Aircraft instrumentation and IFR pilot skills are a major factor in conducting safe navigation from departure to destination and making safe and successful landings in poor visibilities. Pilots are expected to closely adhere to the route of flight filed on their IFR flight plan or the route issued by the controller. The controller should always be advised of any deviation required from the intended route. This same rule applies to altitudes. IFR pilots are expected to maintain the assigned/required altitude and again advise the controller of any required deviation from that assigned.

COMMON ELEMENTS OF IFR FLIGHT

Unlike the chapter titled "Common Elements of Multiplayer Flight" that describe elements of flight that apply equally to VFR and IFR flight such as airspace, airways, flight plans, navigation and others, here I'll discuss elements or IFR operations that apply equally across various IFR flight scenarios such as flight deviations, descents at pilot discretion, missed approaches, pilot intentions, and alternate airports. Again this is done to save time and paper from being wasted repeating these subjects while explaining various IFR topics. So, keep in mind that these elements can apply when and where necessary during an IFR flight.

IFR FLIGHT DEVIATIONS

Deviations are defined as a departure from a current clearance, such as an off course maneuver to avoid weather or turbulence. This definition applies equally to deviations by a VFR or IFR pilot. In the case of the VFR pilot it was necessary to keep the controller informed about requirements to deviate around clouds because the VFR pilot is not allowed by regulation to enter clouds and because the pilot may not have the proper training to keep the aircraft flying straight and level in an environment without visual references such as the horizon. Also controllers do not have a first hand view outside the pilot's cockpit window to see the immediate surrounding weather or obscuring phenomenon which may adversely affect VFR flight.

A pilot flying IFR doesn't have to worry about going around clouds; rather they can stay on the exact flight track going right through most weather because the regulations allow this and the IFR pilot is typically trained and qualified to maintain proper control of the aircraft and navigate in an environment with no visual references.

There are times though when the IFR pilot must do just as a VFR pilot and request deviations from the intended flight path. In the IFR pilot's case it usually applies when the weather becomes dangerous to the aircraft and passengers such as encountering a thunderstorm cell, squall line, extreme icing, hail, severe turbulence or any extreme weather conditions that effect aircraft/passenger safety. In such cases the IFR pilot notifies the controller of the requirement to deviate around such weather and the controller is obligated to allow the pilot to circumnavigate the weather as requested.

The IFR pilot typically uses onboard radar to spot weather that can be trouble and coordinate with ground controllers who also use radar to keep an eye on weather. The core of a thunderstorm is not the place for ANY aircraft.

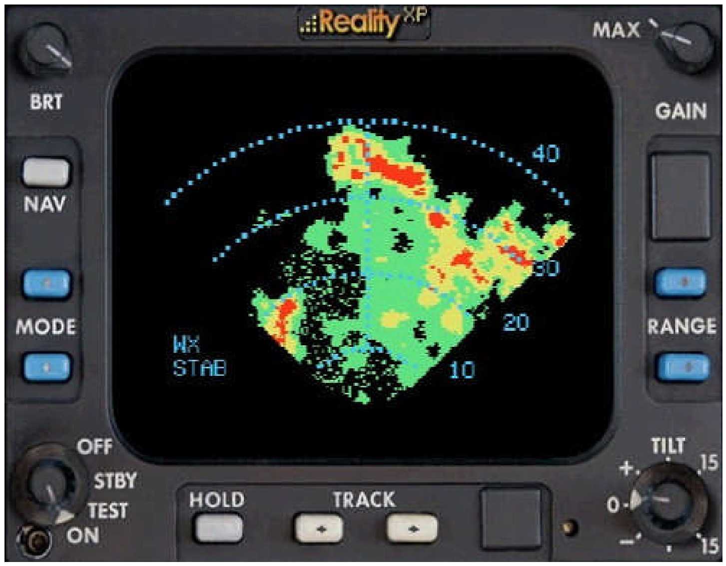


Figure 289 - RealityXP WX500 airborne weather radar for the flight simulator.

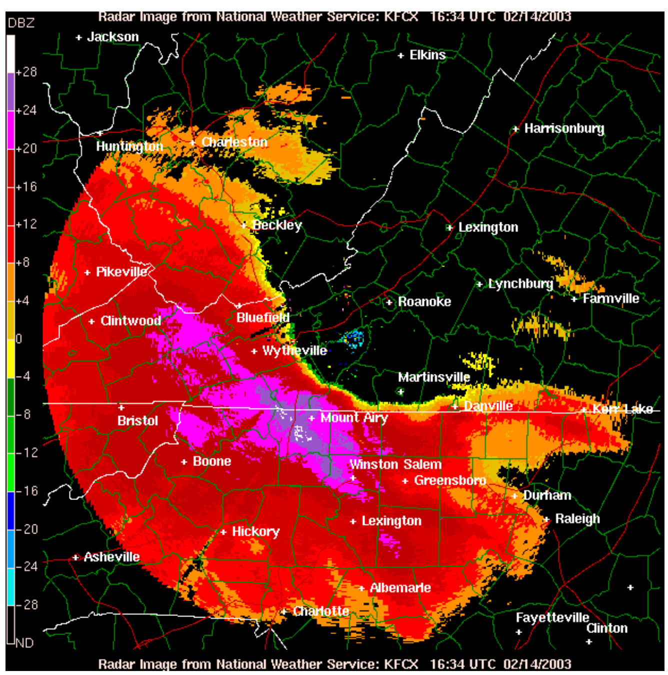


Figure 290 - National Weather Service radar image of extreme weather conditions.

An example of requesting a flight deviation is as follows:

Atlanta Center N9COF requests a right turn 20 degrees for weather.

If required the pilot can also request a climb or descent (as applicable) to avoid severe weather as follows:

Atlanta Center N9COF requests descent to flight level 280 for turbulence.

Remember, in real-life *the rules of compliance for ATC clearances and instructions reads similar to this:*

When an ATC clearance has been obtained, no pilot may deviate from that clearance unless an amended clearance is obtained, an emergency exists, or the deviation is in response to a traffic alert and collision avoidance system resolution advisory (that's a TCAS RA folks!). Except for Class A airspace (the airspace from FL180 up to FL600) a pilot may cancel an IFR flight plan if the aircraft operation is being conducted in VFR weather conditions. When a pilot is uncertain of an ATC clearance, the pilot shall immediately request clarification from ATC. Also except in an emergency, no person may operate an aircraft contrary to an ATC instruction in an area in which air traffic control is exercised.

So let me emphasize here again what has been said about a clearance. If ATC provides you a specific clearance you must follow that clearance unless some extreme condition exists for you to take action and deviate from it such as an emergency or immediate traffic conflict. It also said that when the aircraft is within controlled airspace the pilot is under strict control of ATC (*you can not cancel your IFR clearance*) but if you are not flying in strictly controlled airspace then there is a loophole (a loophole, how do you get a loophole in a clearance?). Well, if you are not flying in a strictly controlled airspace such as Class A airspace or an airport control zone the pilot has the option to cancel an IFR clearance (or flight plan) and continue flying VFR while in VFR weather conditions (pilot's are not legally allowed to cancel an IFR clearance or flight plan while still in IMC conditions).

This loophole should be used with caution. In real-life I've known many a corporate pilot who "fudged" getting into their home base airport (typically an uncontrolled airport without ATC control) during inclement weather by canceling an IFR clearance so as to dive through a "hole" in the weather and attempt a VFR approach and landing in more than marginal VFR conditions. Not a good idea! Pilots compromise their safety and their passenger's safety doing this. There are many other reasons a pilot may use this option but again most of the reasons typically override safety which is never in anyone's best interest. Follow through with procedures and stay safe!

DESCENTS AT PILOT DISCRETION

There are times when controllers start bringing aircraft down from their cruise altitude that they provide some flexibility to the pilot allowing them to descend at their own discretion. The definition of "Pilot's Discretion" is <u>when used in conjunction with altitude assignments, means that ATC has offered the pilot the option of starting *climb or descent* whenever s/he wishes and conducting the *climb or descent* at any rate s/he wishes. S/he may temporarily level off at any intermediate altitude. However, once s/he has vacated an altitude, s/he may not return to that altitude.</u> The request might sound like this "descend at pilot's discretion to 6000 feet". Notice I emphasized the words climb or descent, because *ascents at pilot discretion* are applicable here too.

Then other times the controller might tell the pilot to descend to a specific altitude before reaching a specific fix such as "descend to 5000 feet before reaching Lima". This type descent is referred to as a crossing restriction defined as <u>an altitude used by ATC when a specific altitude restriction at a specified fix is required</u>. Crossing restrictions can work in reverse for ascents also. For instance, the controller might request the pilot to reach a specific altitude while climbing before crossing a specific fix (required for obstacle clearance) such as "climb and maintain 8000 feet before reaching Juno". So what if you can't reach the altitude in the remaining distance? Well, tell the controller you need to hold (basically going in circles while climbing) until you can reach the required altitude. It is like taking off in a Cessna at an airport boxed in by mountains on all sides. You may need to go in circles while climbing to reach a safe altitude to cross over mountain tops and get under way. While flying privately in the Appalachian Mountain range I had to do this on occasion myself <grin>.

At other times the controller might tell the pilot that they need them to maintain an altitude until reaching a given point such as "maintain 6000 feet until reaching Oscar". Such a request is referred to as an altitude restriction defined as an altitude or altitudes, stated in the order flown, which are to be maintained until reaching a specific point or time. Altitude restrictions may be issued by ATC due to traffic, terrain, or other airspace considerations. *As stated altitude restrictions can reference a time*.

It is not abnormal for a controller to be vectoring an aircraft for an approach and tell the pilot something like this "cleared direct BZM VOR, descend to 5000, maintain 8000 until crossing BZM. This means the pilot is to leave from his present position and head directly for the VOR named BZM descending to 5000 feet but maintaining 8000 feet until the aircraft crosses over the VOR.

MISSED APPROACHES

I briefly discussed missed approaches as they applied to the VFR pilot but when it concerns an IFR flight missed approaches are a whole different ball game due to the poor visibilities an IFR pilot may encounter during an approach for landing. This is a very important topic to cover as not all landings can be successfully completed and when the case arises a pilot must know when and how to react. So I'm going to explore IFR missed approaches with you in detail here. Forgive me if I pound this one with a hammer. *All pilots must understand exactly how to think and how to react when reaching the DH (Decision Height) or MAP (Missed Approach Point), there can be no second guessing at these critical points.* You are at a specific location at a minimum altitude for safety which means you are dangerously close to terrain and obstacles. This is not the place for a debate! These points in space have been plotted, examined and plotted again when sitting at a desk where altitudes, location, and timing were not a matter and later tested in clear weather. The thinking has already been done, don't try and rethink these things at the missed approach point during inclement weather, just do it as prescribed and avoid tragedy!

By definition a missed approach is *a maneuver conducted by a pilot when an instrument approach cannot be completed to a landing. The route of flight and altitude are shown on instrument approach procedure charts. A pilot executing a missed approach prior to the Missed Approach Point (MAP) must continue along the final approach to the MAP*. The definition of the MAP is *a point prescribed in each instrument approach procedure at which a missed approach procedure shall be executed if the required visual reference does not exist*. Also by definition it is noted that *at locations where ATC radar service is provided, the pilot should conform to radar vectors when provided by ATC in lieu of the published missed approach procedure*.

One of the most important factors of course is the weather. We are talking about IFR conditions in this section but what is weather to the pilot in this situation? Weather creates an obstruction to vision normally by visible moisture present in the air; it is a cloud or possibly fog on the ground (fog is nothing more than a cloud at ground level). This impairs the ability of the pilot to *see dangerous obstructions* or *make visual contact with the airport or runway environment* to conduct a safe landing. Just because you have an ILS doesn't mean you are *safe to descend all the way to the ground*, on the contrary. If you examine charts randomly you will find most ILS approaches (in this case a CAT I ILS) will take you to a very low altitude (*typically around 200 feet AGL*) but not lower *unless* (*unless what?*). Well, you *must* be able to *see* the *runway environment*, and *keep visual contact until landing* but hold on there is more to this…

There are real-life aircraft and airports properly equipped, and crews certified to perform *zero visibility* landings when the weather is extremely bad (categorized as CAT III ILS approaches), but the fact is the vast majority of aircraft, pilots, and airports are *not certified* to conduct this type of zero visibility landing. That doesn't mean you can't simulate this type landing in the flight simulator, you can, because there are now complex modeled aircraft that can conduct *autolandings* simulating the CAT IIIC landing. These aircraft will be comprised of *dual operating autopilots* that when properly configured will take the aircraft down the ILS to the runway, flair the aircraft for landing on the touchdown zone of the runway, retard the throttles, and steer the aircraft down the center of the runway all under the watchful eyes of the pilot even when s/he can't see the runway. Cockpits that have multiple autopilots and an autoland status indicator are a good hint that the aircraft may be modeled to perform autolandings.

Figure 291 - MCP panel with multiple autopilots.

Figure 292 - Autoland Status Indicator.

When it concerns standard instrument approaches (something other than an ILS CAT IIIC approach) there are normally always some sort of *minimums* (speaking of altitudes) involved that *restrict your descent to the runway at a given point unless you can see the runway environment* (this includes the ILS CAT IIIA and B approaches). Real world IFR regulations spell out a *bunch* of criteria for going below the DH (Decision Height) for precision approaches or the MDA (Minimum Descent Altitude) for non-precision approaches, to continue the descent and land on the runway. It again depends on the type of approach used, how aircraft and airports are equipped, pilot certifications and skills and on and on. It sounds as if we would never get back down to earth <grin>.

Well in the virtual world we can trim off the really serious stuff and stick to some simple rules but before we go further let's talk about simulated weather (the stuff that really impacts what we are talking about here) then come back to our topic.

I discussed weather simulation back in chapter 2. Weather simulation has gotten much better in flight simulators over the years especially the eye candy portion, but has never been a bright spot when we talk about providing a real-time/real-world simulation of weather during multiplayer activities. In review, there are many programs that can simulate weather using real-time data from real world conditions, but typically only in the single player environment. More accurately done a multiplayer server might retrieve real world weather data itself that all the clients could tap for the same weather scenario (again something else to put everyone on the same playing field). Since most online ATC services do not have this real-time capability they fall back on fixed weather scenarios provided by the host program, or have at minimum a program to cycle the host weather periodically. These are setup on schedules to change at appointed times cycling through a specified time period with fixed, but different weather patterns. Currently most servers provide authorized controllers with proper access to manually set weather for any given pattern at will. This can be useful at times also, say to setup a given weather scenario to practice specific approaches or create a challenging flight scenario for an activity. They may manually set the weather during the start of an ATC activity to be modestly cloudy and later change it to end in gray, rainy, and fogged in for instance. Not only can cloud type, winds, temperature and the like be managed but more importantly landing visibilities can also be set to much more challenging levels with say a quarter mile visibility that would make an ILS approach truly needed even in the simulator. It doesn't provide much of a challenge when you fly an ILS and the runway can be seen 10nm out, which is not the reason for such an approach unless you need practice. Of course in the end the most realistic way is to feed real-world weather data in real-time to the host to be used by the server so it creates that wonder of mother nature, never knowing what the outcome will be when you reach the DH or MAP.

Okay back to the topic of missed approaches, how do we handle reaching the DH or the MAP?

Simply put by the regulations *the pilot must be able to see the* ***runway environment*** *by using whatever* ***landing aids*** *are available* (such as lighting systems, runway markings and such) *with an* ***aircraft position and attitude*** *that will allow a* ***normal descent rate*** *and* ***no unusual maneuvers****, to allow a safe landing* ***UNDER VISUAL CONTACT***.

From the above statement there are two primary problems present that can greatly affect the simulator pilot. First the visibility factor, and second the angle of descent required to complete the landing. Before I discuss these two problems let me clear up some definitions. Maybe someone has noticed I point out the MDA one moment and the MAP the next depending on how I reference them. What are these and the DH I mentioned and how do they fit into instrument landings. The easiest way to answer that is to define each.

DH (Decision Height) is defined *with respect to the operation of aircraft, means the* ***height at which a decision must be made*** *during an ILS, MLS, or PAR instrument approach* ***to either continue the approach or to execute a missed approach****.*

Note: Disregard MLS (Microwave Landing System) in this definition as it is beyond our discussions here. Also notice that each instrument approach mentioned above is a precision instrument approach. *The decisive factor that defines a precision and non-precision approach is the electronic glide slope.* If you don't have a glide slope provided the approach is a non-precision approach.

MDA (Minimum Descent Altitude) is defined as ***the lowest altitude****, expressed in feet above mean sea level,* ***to which descent is authorized on final approach or during circle-to-land maneuvering*** *in execution of a standard instrument approach procedure* ***where no electronic glide slope is provided****.*

Note: As you can see this definition shows the difference when using the DH or MDA reference. MDA applies to those approaches "…where no electronic glide slope is provided." DH is used when a precision approach is being conducted.

MAP (Missed Approach Point) is defined as ***a point prescribed in each instrument approach procedure at which a missed approach procedure shall be executed if the required visual reference does not exist****.*

Note: You can see here just one piece of the definition vitally important "…required visual reference does not exist." This tells you that barring any exceptions such as a CAT IIIC type landing all approaches generally have requirements to "see" the runway or airport environment to continue a landing to touchdown.

Now let me dive into this angle of descent problem. *During a precision approach the MAP is the DH* (one in the same) because the DH is the point where the pilot decides to go missed approach. This is great because typically the DH is about 200 feet AGL (in the case of a CAT I approach) and very close to the runway threshold. This puts the aircraft in a great position for landing where a normal descent rate can be maintained and unusual maneuvers are rarely required because the angle of descent required with the aircraft at this point is spot on. ILS landings *typically* have a 3° angle of descent down the glide slope typically starting at the final approach fix (FAF). Notice in figure 293 circled in red a small note reading GS 3.00° with a line then TCH 54. That is the glide slope angle (3°) and the TCH 54 is the runway threshold crossing height (54 feet AGL).

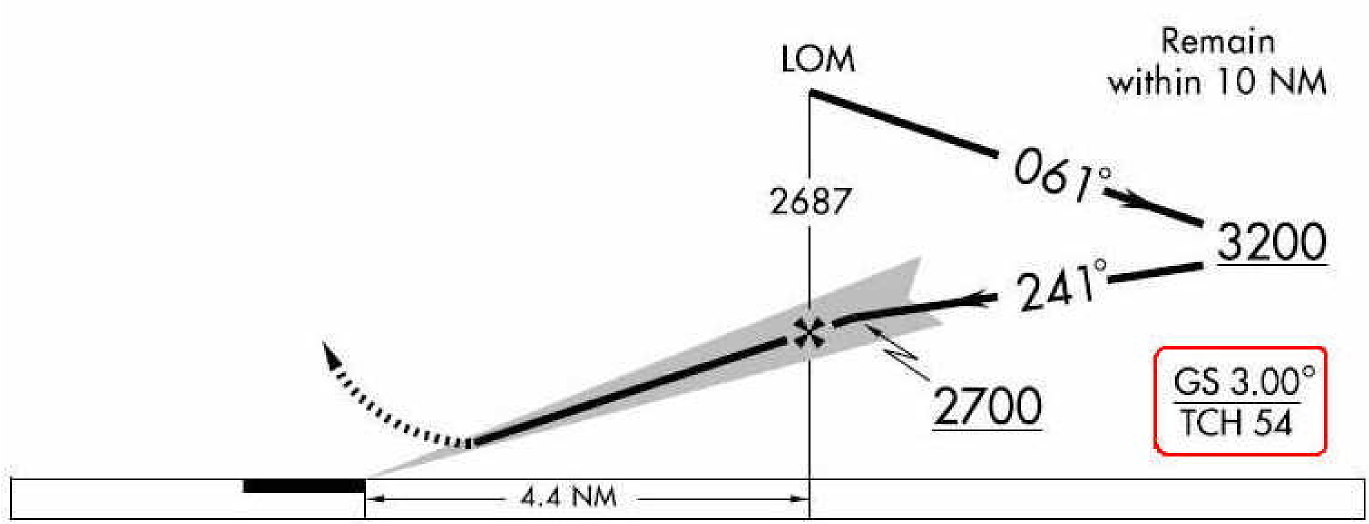


Figure 293 - Profile view of an approach.

Unlike a non-precision approach that I'll discuss shortly the precision approach maintains the proper angle of descent for the pilot along a specific path so as to reach a point where the aircraft fully configured and stable in flight can continue the descent to landing IF THE RUNWAY ENVIRONMENT CAN BE IDENTIFIED AND VISUAL REFERENCE MAINTAINED UNTIL TOUCHDOWN!.

So basically just before or when the pilot reaches the DH the runway will normally be right in front of them with the aircraft already on the proper glide slope, reference figure 294 which depicts a normal ILS landing with the runway environment coming into view at the DH with the aircraft able to continue the descent safely at a normal angle of attack.

Figure 294 - A normal ILS landing.

This is not the case during a non-precision approach (which doesn't have a glide slope). The MDA (Minimum Descent Altitude) is an altitude that the pilot must maintain until reaching the MAP. So what happens is this, depending on *WHERE* along the flight path of the final approach the pilot identifies the runway environment will determine the angle of descent! Notice figure 295 in the following explanation. The MAP is typically some point close to the threshold of the runway similar to an ILS but the MDA in a non-precision can be much higher than the 200 foot AGL DH as in the case of an ILS CAT I landing, because the non-precision approach is missing the electronic glide slope that allows the pilot to descend safely to this lower altitude. The MDA can be hundreds if not thousands of feet AGL depending on nearby obstacles and terrain. This presents a problem for pilots.

Non-precision approaches that I cover are the LOC, VOR, NDB, and GPS. I mentioned earlier that these approaches normally use *step down altitudes* to get the pilot to the *lowest and safest altitude* that can be reached *to acquire the runway* (this is the MDA). As defined the pilot, during these non-precision approaches must not descend below the stated MDA unless the runway environment is acquired and visual contact can be maintained until touchdown. The problem develops when the pilot properly maintains this MDA altitude but reaches *a point along the approach path where the descent angle becomes unsafe if the runway environment is visually acquired at the last moment* (typically just before reaching the MAP). Keep in mind as explained above that *the approach must be able to be completed at a normal descent rate without unusual maneuvers.*

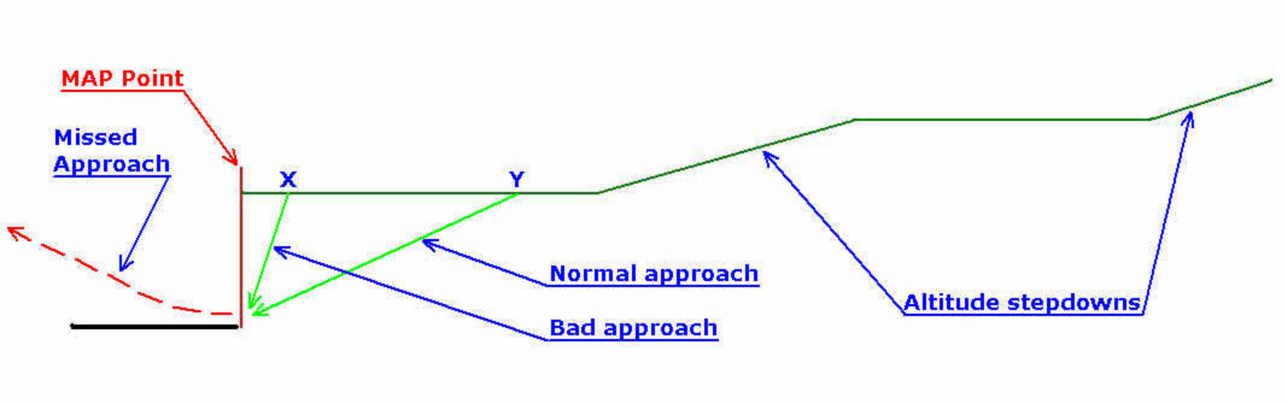


Figure 295 - Non-precision approach profile view.

Example, I'll exaggerate this slightly to get the point across using figure 295 as a reference again, if a particular runway threshold is at an altitude of 300 foot MSL and the MAP is only say .2 miles from the end of the runway but the MDA is 2000 feet MSL (along the line where the X and Y are in figure 295) then if the pilot acquires the runway at, lets say approximately .4 miles (.2 miles from the MAP) the angle of descent to reach the runway is extremely steep from 1700 feet AGL (reference the green line from point X to the runway in figure 295) at less than half a mile from the runway threshold (2000 MSL minus the 300 MSL equals 1700 AGL the aircraft must descend). If the pilot acquires the runway at this point then a very steep approach angle is necessary and causes the pilot to make *unusual maneuvers and abnormal descent rates* to even try to complete the landing. Bad move!

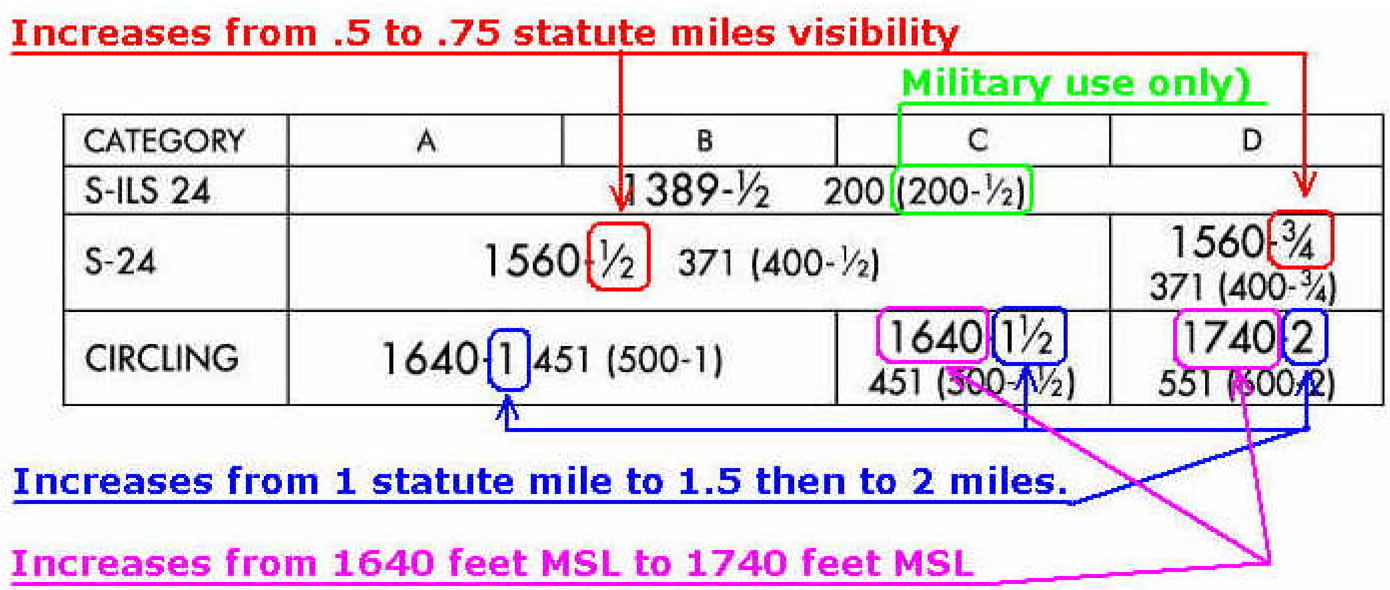
So you can see it is already too late to continue a safe approach even though the pilot has not reached the MAP as yet. In such a case the pilot might need to acquire the runway as far as a mile out (reference point Y) to be able to safely descend below the MDA and continue the approach to the runway at *normal descent rates without unusual maneuvers* (just as if they had completed an ILS approach with a glide slope that starts the descent miles from the runway).

If you examine various non-precision approaches you'll notice that required visibilities are typically higher due to just this problem. They are higher because the pilot must be able to see the runway farther away. The required visibility for an ILS landing can be much less than a non-precision approach because the glide slope helps the pilot descend safely to a point much closer to the runway threshold to acquire the runway visually and complete the landing. As a pilot progresses through the non-precision approach the angle of descent keeps getting greater and greater if the MDA is maintained as shown in figure 295. So pilots must use good judgment during non-precision approaches and know when to execute the missed approach. *Don't forget that if you decide to go missed approach BEFORE reaching the map you must proceed on the approach path until you reach the MAP and only then execute the missed approach procedures from that point. Let me state this again, if you decide to go missed and have not arrived at the MAP stay on the proper flight path until you do arrive at the MAP and then execute the missed approach!* Missed approaches are designed to be executed starting at the MAP. If a pilot executes a missed approach either far before or far after the MAP then this may put them in danger of hitting ground obstacles or terrain outside the intended missed approach area.

Now let's discuss the other issue about landing visibilities and present another example. You'll find that the visibility problem is intertwined with the angle of descent problem.

Many pilots training for the IFR certification might be on a precision or non-precision approach and the forward visibility may be zero but looking straight down may not be so bad; the ground may even be in sight. Ever fly on an airliner looking out your window seat at the ground and thinking "not so bad", but up front the pilot and co-pilot are thinking "gosh darn I can't see a thing!" It is because they are looking forward for the runway.

The problem occurs (during a non-precision approach) when the pilot gets over the runway threshold (or MAP) that they couldn't see while looking forward, then looks down to see the runway threshold and tries to make a dive for it (very bad idea!). If you're looking straight down and see the runway it is already to late, GO MISSED APPROACH! Sound like the same problem dealing with the angle of descent? Well it is the same problem, but stick with me here for a minute there is something else to learn. This is why when you examine an approach chart there is not only a minimum altitude (for safe obstacle clearance) but also a required visibility, and let me add to this, have you ever noticed that the visibilities and minimum descent altitudes increase for larger aircraft? Reference figure 296, notice that the minimums change for category C and D aircraft (larger aircraft), unlike smaller aircraft, larger (commercial) aircraft need more room to maneuver and correct their position due to higher landing speeds hence increased minimum altitudes and visibilities. I'll talk more about approach charts later in this chapter.



CATEGORY	A	B	C	D
S-ILS 24	1389-½ 200 (200-½)			
S-24	1560-½ 371 (400-½)			1560-¾ 371 (400-¾)
CIRCLING	1640-1 451 (500-1)		1640-1½ 451 (500-1½)	1740-2 551 (600-2)

Figure 296 - Approach minimums as seen on an approach chart.

Also, the cockpit of a B747 when on the runway sits far from the ground so when the visibility is bad the B747 Captain sitting in that high perch possibly doesn't have such a grand view of the runway that the pilot in a Cessna who is practically sitting on the ground would have in comparison. Also, that 150 to 200 foot wide runway is lots of room for the Cessna but tends to look very narrow for the B747 pilot. Then just consider the physics, a Cessna weighs thousands of pounds whereas a B747 weighs hundreds of thousands, not something to take lightly, smooth landings are the pick of the day.

So you can see there are various types of visibilities to consider, and the forward visibility is really primary because the further out the pilot can acquire the runway the better. The pilot can start a descent from a non-precision MDA that will be safer and easier to maintain throughout the approach.

Remember I discussed briefly another way of *measuring forward visibility*. Even though not a factor in the flight simulator today (*it isn't simulated*) I will mention it again to broaden your perspective about visibilities. At real world major airports they have a piece of equipment that sits next to the end of a runway called a "Transmissometer" to measure RVR (Runway Visual Range). They look sort of like telescopes (reference figure 297). One shoots a beam of light to the other.

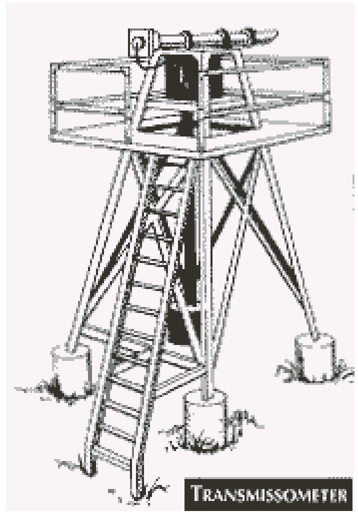


Figure 297 - A Transmissometer, part of an RVR system.

Depending on how well the receiving scope *sees* the light from the other it will provide the control tower with a measurement that can determine how well pilots will see in a forward looking capacity. These scopes are actually measuring the vapor density between the two scopes, the denser the vapor the less light that gets through. Hence the scientists have figured out for us what densities translate into the visibilities we get. There are published approach charts that use these RVR measurements to determine landing criteria other than visibility in statue miles. This allows the pilot to get better minimums for landing the aircraft. In other words, depending on the RVR measurement obtained the pilot can get lower minimums (with better RVR readings) because the pilot will be able to see farther and better in a forward looking capacity. If the RVR readings are bad the minimums go back up.

How does this effect landing an aircraft, well again, forward visibility is where it's at folks, pilots need to understand that maintaining their aircraft in a normal angle of descent properly trimmed, with proper airspeed, with a stable vertical descent rate on an instrument approach puts the aircraft in a position where no sudden changes need occur to continue an approach if the runway is visually acquired in a forward capacity at the correct point. If you acquire the runway like this then you can continue the approach to touchdown (as simplified in the virtual world).

A rule of thumb is this, if you get the urge to make any sudden brute changes to your flight configuration at the point where you meet the DH or MAP to try and make a proper landing DON'T! That *is your decision to go missed approach* because something isn't correct. If all is correct you should be able to maintain your current configuration until touchdown with the runway *locked in your sights*.

Figure 298 - Proper runway acquisition.

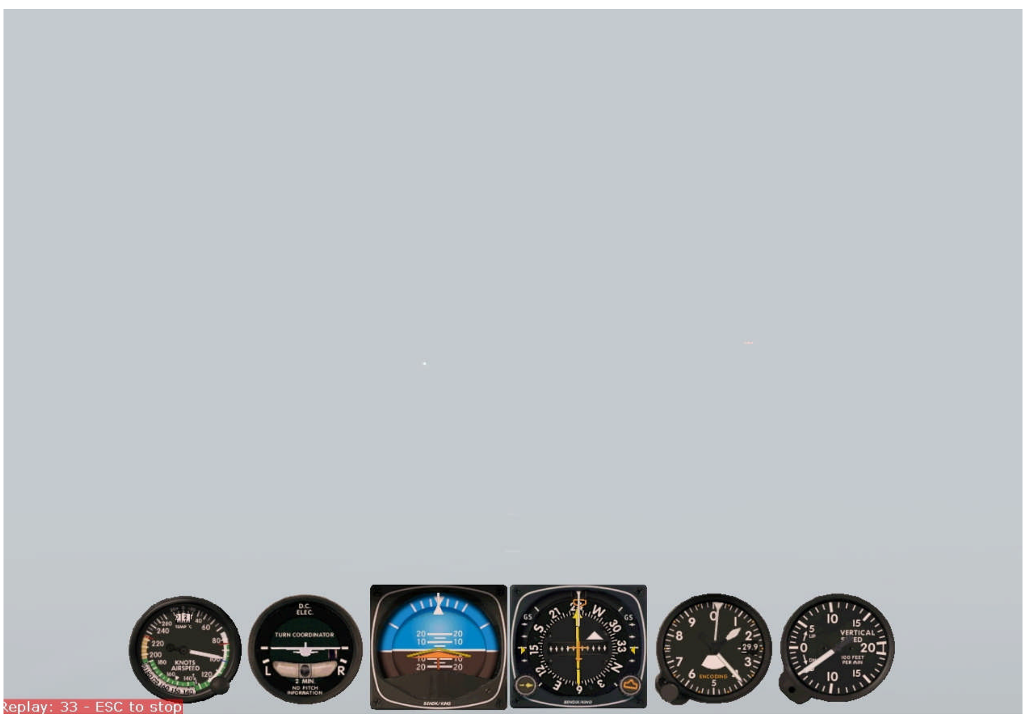


Figure 299 - No runway acquisition.

So we have talked in depth about the DH, MAP, and MDA, about forward looking visibility, and how to judge when it is time to go missed approach. Now let's talk about the missed approach itself (the procedural part, not the technical part such as reading the chart. All published instrument approaches have missed approach procedures. These procedures are clearly laid out on instrument approach charts expressed in simple visual and written terms. Compare figures 300 and 301.

MISSED APPROACH: Climb to 1600 then climbing right turn to 4000 via heading 340° and BZM R-274 to BZM VOR/DME and hold.

Figure 300 - Written missed approach procedures.

Figure 301 - Missed approach procedures at-a-glance.

Missed approach procedures are part of every pilots preflight planning. A pilot doesn't wait until the approach to get familiar with going missed approach. That could spell trouble. So every pilot should have the approach charts necessary for the destination (*and alternate*) airports reviewed and handy. All my discussions about instrument approaches cover details about the information contained within the approach charts for each type of approach such as ILS, VOR, NDB, and GPS including graphics and annotations.

So let's go over the scenario for a missed approach at a *controlled airport* first. You're conducting an ILS approach and reach the DH, no runway environment to be found what's next?

First execute the missed approach, don't worry about declaring it just yet, and why? Well for one you are *low and slow* and without acquiring the runway need to get back up where you are for sure safe, there will be airport and terrain obstacles dangerously close to you in most cases and hanging around at those lower altitudes isn't good. So push that TO/GA button or shove the throttles to full power and *get the aircraft climbing immediately*! Don't go any lower than the DH and maintain the runway heading until you are climbing and the aircraft is *cleaned up* (flaps coming up and gear up). Once situated declare to the tower controller your going missed approach (the controller will have a fair idea things didn't go good by watching your progress on the radar).

What about if you are conducting the approach at an *uncontrolled airport?* Well, declare the missed approach on the CTAF frequency *first* (remember you need to tell pilot's at the local airport on the CTAF frequency you didn't land), then when you do switch back to the approach controller handling your landing declare the missed approach with them too (we covered this earlier in this chapter).

Typically the tower controller at the controlled airport or approach controller handling your approach into the uncontrolled airport will still be available on the radio (the typical situation) and you'll be provided instructions immediately after declaring the missed approach. Follow the controller's instructions and provide your next intentions, either to try the approach again or divert to the alternate airport.

If you did happen to lose communications at this critical point with either the tower controller during an approach at a controlled airport or the approach controller during an approach to an uncontrolled airport for any reason, follow the missed approach procedure on the chart until you reach the holding point and start holding there as prescribed until you establish proper communications. If you can not establish proper communications then follow procedures for loss of communications. Lost communications tend to throw a major curve ball in a pilot's thinking cap as it is very rare and unexpected. Don't be caught off guard, know your loss of communications procedures. In the virtual world there are ways to handle this reference chapter 3 under the section titled "Communications Failure".

PILOT INTENTIONS

Just after a missed approach is a prime example when the pilot must tell the controller what their next intentions are, like the VFR pilot entering controlled airspace. Below is a list of intentions normally applicable to the IFR pilot. Remember that it is common for flights to be filed as IFR even in VFR conditions. It is recommended for pilots to fly IFR even in VFR conditions to remain proficient. So some intentions may apply to VFR conditions only.

Full Stop Landing – The pilot intends to make a full landing, including taxi to parking.

Touch & Go(s) – The pilot intends to complete an approach, landing on the runway followed with an immediate take off. (The aircraft does not come to a stop.)

Low Approach(s) – The pilot intends to complete an approach and perform a runway flyby followed with an immediate departure. (The aircraft does not touch down.)

Visual Approach – The pilot intends to complete a visual approach, followed by either a low approach, or touch & go or full stop landing.

ILS Approach – The pilot intends to complete an ILS instrument approach, followed by either a low approach, or touch & go or full stop landing.

VOR Approach – The pilot intends to complete a Variable Omni-range (VOR) approach, followed by either a low approach, or touch & go or full stop landing.

NDB Approach – The pilot intends to complete a Non-directional Beacon (NDB) approach, followed by either a low approach, or touch & go or full stop landing.

GPS Approach – The pilot intends to complete a Global Positioning System (GPS) approach, followed by either a low approach, or touch & go or full stop landing.

Proceed to Alternate – The pilot intends to proceed to an alternate airport due to weather or other reason that prevents landing at the destination airport.

Hold – The pilot intends to enter a holding pattern to possibly resolve an aircraft malfunction or for any other possible reason such as waiting for weather to change.

ALTERNATE AIRPORTS

We brought up the subject of alternate airports in our discussion about missed approaches but let's review some things specifically about alternate airports. Why the alternate? In real-life if the weather is below minimums at the destination airport (*they call it "socked in"*) the pilot may have to divert to an alternate airport. By definition an alternate airport is defined as *an airport at which an aircraft may land if a landing at the intended airport becomes inadvisable*. If the pilot has made reasonable attempts to land at the destination airport but failed to complete the landing or is advised that weather will not be agreeable at the time of arrival (such as severe thunderstorms) then proceeding to the alternate is required, the alternate airport is the *preplanned* airport of second choice to conduct a landing.

How do real-life pilots decide on an alternate? FAR 91.169 provides for certain criteria to be met to use an airport as an alternate. Again there is more real-life criteria then what is necessary in the virtual world but using the FAR as a baseline we can set a rule of thumb that *if the visibility will be 2 miles or greater and a ceiling of 800 feet AGL or greater at the estimated time of arrival then the airport can be used as an alternate*. Most virtual pilots capable of conducting an ILS or non-precision approach can easily deal with such a visibility and ceiling.

Someone may be asking “but how do you simulate this?” when the weather tends not to change realistically on the host server. Well, it is done manually by the controllers selecting the proper settings within FSHost. Controllers who have access to FSHost can change the weather scenario. If properly trained they can recognize the need to “simulate” the weather required for a particular pilot at the time of there landing. A problem that might occur though is another pilot landing at the same exact time would also experience the same weather because weather changes on the host server are global in nature.

So controller skill will determine the outcome of the experience overall for pilots. Remember, FSHost can not (at the time of this writing) provide real-time, real-world, station based weather for the clients (pilot’s) but I do know of one weather scheduling program for FSHost that can automatically cycle preplanned weather scenarios every 1 hour. If such a program were made more complex so as to allow the changes to occur more often, say every 5 minutes (minimum) and where many of the parameters of weather can be set to vary each period either up or down (in other words such as the altimeter setting climbing to a specific point and then decreasing again over a set period of time) then with all the different weather settings combined the weather scenarios could be made more unexpected. It will be a great day when station based real-world weather can be implemented that makes mother nature once again, for the most part unpredictable for IFR (and even VFR) simulator pilots during multiplayer activities.

Also I should mention during flight planning real IFR pilots are required to follow FAR 91.167 *Fuel Requirements for Flight in IFR Conditions*. For virtual purposes a good rule of thumb is *enough fuel to fly from the departure airport to the destination airport then from the destination airport to the alternate, and then fly after that for 45 minutes at normal cruising speed*. Or maybe even more acceptable, enough fuel to fly from the departure airport to the destination airport, then attempting a minimum of two approaches, then from the destination airport to the alternate, then attempting another two approaches. We know the flight simulator normally *tops off the tanks* automatically at the start of a flight unless you happen to be using one of the nifty utilities to manage this and in most cases fuel will not be a factor for most pilots but for those serious simmers that have realistically modeled aircraft they might like to put a hefty payload on their aircraft, calculating some sort of practical fuel load (most likely very less than full) will be a necessity because if they don’t the aircraft will be left in an over weight condition. Fuel requirements are not something an ATC service will be concerned with as it is a pilot function so I include the information mainly so virtual pilots will know what to look for and practice.

IFR FLIGHT SCENARIOS

Typically there are only four basic scenarios of IFR flight when it comes to the type of airport being flown from and to. Here is a list of the possible flights:

1. FROM a controlled airport TO a controlled airport.
2. FROM an uncontrolled airport TO an uncontrolled airport.
3. FROM a controlled airport TO an uncontrolled airport.
4. FROM an uncontrolled airport TO a controlled airport.

In the reading to follow I will break down IFR flight with the first two scenarios, FROM and TO *controlled* airports, and the other FROM and TO *uncontrolled* airports. Now before someone asks “*but what if I’m flying FROM a controlled airport TO an uncontrolled airport*” or vice versa “*what if I’m flying FROM an uncontrolled airport TO a controlled airport*” as in 3 and 4 above, what then?

Well, by the time you have read through a description of the first two scenarios you’ll realize that you can “chop” them into two pieces, dividing them in the center of the flight typically where the aircraft is with a center controller so as to create the last two scenarios as required. You’ll see it is easier than you might realize at the moment. That way I don’t have to make this chapter more complicated or longer than necessary writing every possible scenario. Learn the first two scenarios (*keeping in mind they are building blocks*) and you'll know how to conduct any of the flight scenarios (1 through 4) above.

IFR FLIGHT FROM AND TO CONTROLLED AIRPORTS

This scenario is a multiplayer favorite because it tends to be the simplest and easiest to manage by most pilots who typically have the skills to conduct this type flight. Unlike flying from and to uncontrolled airports (we'll tackle that shortly) the pilot here basically follows the flight plan, controller instructions, and will typically conduct an ILS approach to the landing (one of the easiest approaches to complete). You'll probably catch me <grin> sneaking in some reviews of previous topics here in this section from chapter 3 "Common Elements of Multiplayer Flight" in an effort to reinforce the lessons.

DEPARTING IFR FROM A CONTROLLED AIRPORT

When the IFR pilot climbs into the virtual cockpit there are some preliminary things to take care of. Most important is the IFR flight plan. I discussed flight plans in detail within chapter 3 so only a brief review here should be required. To demonstrate an IFR departure from (and later the arrival to) a controlled airport I'll use an example IFR flight plan that goes as follows:

The flight will depart Charlotte/Douglas International airport (KCLT) and proceed to Spartanburg VOR connecting to Jet Airway 37, then to waypoint AJFEB on J37 where the approach to Atlanta Hartsfield International can be conducted. The alternate airport is Nashville TN. So the flight plan strip to enter into the flight simulator chat window to send to FSHost would look like this:

Figure 302 - The IFR flight plan strip for the flight.

Remember, the runways indicated in this virtual flight strip are provided for the controller just in case the pilot preloads a navigational device such as an FMC which might require a departure runway as part of the data. Another instance where a runway is required is when a SID will be used for the transition to the airway. Most SIDs are designed to work with a specific airport runway. Even if no such requirement exists the expected runway for departure should be indicated by the pilot just so the flight strips are the same each and every time filed. So each pilot should be aware to always choose the expected runway based on the current server wind direction and speed. Controllers regardless, always have the final say on the runway to be used.

It helps to file the flight plan (send it to the FSHost server) as early as possible as the controllers will be busy trying to build flight routes into FS Navigator using your flight plan. During departures controllers are very concerned with the first one or two fixes after takeoff. These are the ones that take the aircraft to the intended airway en route. If you file the flight plan late it can put the Clearance Delivery controller in a pinch trying to make sure the appropriate information about your flight will be available to all the controllers working the activity. So file your flight plan first then prepare the aircraft for departure by programming the GPS or FMC and completing the cockpit checklist. This will give the controller time to get his stuff done while you're working on the cockpit stuff.

So now you have the cockpit checklist finished and it's time to start the engines and taxi for takeoff, hopefully the Clearance Delivery controller hasn't pulled all of the hair from their head out and has things ready for you. Call the Clearance Delivery controller to obtain your IFR clearance. Using our example flight the request would go like this:

Charlotte Clearance Delivery N9COF is IFR to Atlanta/Hartsfield clearance on request.

The controller will answer your request as follows:

N9COF Charlotte Clearance Delivery clearance on request, stand by.

The virtual controller may need to click on their browser window (used to access FSHost remotely) to see the flight plan so be patient. They will also assign a squawk code (even if only simulating its use) and get the clearance in their mind to read it correctly. Once ready the controller will call you back:

N9COF Charlotte Clearance Delivery, clearance is available, advise ready to copy.

Make sure to have a pad and pencil ready. If they haven't changed your flight plan (and normally this will be the case) then it will only be a matter of you looking at your flight plan you have and comparing it to what the controller reads you. If any parameters or conditions of the clearance do get modified by the controller write them down so you don't forget them. You'll need to write down the transponder squawk code regardless because this is the first time you'll hear it. The ground controller frequency issued is normally the one assigned to the next controller in the TeamSpeak list (ATC2). The Clearance Delivery controller will also provide the departure frequency, normally the forth controller in the TeamSpeak list (ATC4) if available. If there are only three controllers working then the departure controller will cycle back to the controller labeled ATC1, the Clearance Delivery controller (reference chapter 2 "The Art of Simulating ATC" in the section about "Management of Communications").

The Clearance Delivery controller will read a clearance similar to this:

N9COF cleared to Atlanta/Hartsfield as filed. On departure fly runway heading, climb and maintain five thousand feet. Expect flight level 210 one zero minutes after departure. Departure frequency will be 125.50, squawk 2342. Contact ground on 129.00 when ready for taxi.

The pilot is required to read back this clearance verbatim. *The controller is required to correct any part the pilot does not read back exactly as provided.* Remember, this clearance allows the pilot to proceed en route to Atlanta even under a loss of communications because it clears the pilot as filed to the destination. So if the pilot were to loose all communications with ATC just after takeoff the pilot can proceed per this clearance to the destination. So the clearance must be correct. Once the pilot has properly read back the clearance the controller will acknowledge this and wish them a good flight <grin>.

If the pilot hasn't already done so now is a good time to check the ATIS report. It is a shame TeamSpeak doesn't provide a means to play a prerecorded weather briefing to play back on a specific TeamSpeak channel as discussed in chapter 1 (that would be so cool!). So the best way to get around this is to post textually in the description block of the first TeamSpeak channel (the channel typically used for the ATC1 controller (who normally acts as the Clearance Delivery controller) so each pilot can quickly see it by highlighting the frequency on TeamSpeak. There may also be a link posted there to directly connect the pilot to the FSHost public status web page to get the latest weather. The FSHost public status page will *always* accurately display the current weather; it should always be your primary source. There should also be an ATIS identifier so the pilot can indicate to the controller which ATIS weather "broadcast" has been obtained such as INFORMATION FOXTROT. Jot this identifier down on your pad.

Now the pilot is ready to start engines and taxi to the active runway for departure. The pilot will call the ground controller (typically the next controller listed on TeamSpeak (ATC2) as per the instructions in the initial clearance and request permission for engine startup and taxi to the active runway as follows:

Charlotte Ground N9COF with information foxtrot request engine startup and taxi to the active.

The ground controller will answer the request as follows:

N9COF roger, cleared for engine start, advise when ready to taxi.

Note that if the pilot had not told the ground controller the ATIS identifier "foxtrot" that the ground controller would have provided the weather in the clearance similar as follows:

N9COF roger, wind 240 @ 5 with gusts to 10, visibility 2 miles, clouds overcast at 2000 feet in light rain, temperature 68 degrees dew point 67 degrees, altimeter 29.82, cleared for engine start, advise when ready to taxi.

The pilot does not need to read back the weather verbatim as with the flight clearance but it is typical to repeat the altimeter setting as this setting is critical in IFR operations. The pilot can now start the engine(s) and when ready call back the ground controller to advise ready to taxi.

Let me stop briefly here for a special reminder about pushback requests. Typically a VFR pilot won't request a pushback because the majority of VFR flights are general aviation aircraft related. Only large commercial aircraft tend to require a pushback from a gate or Jetway. This in turn tends to be related to IFR flights because most commercial aircraft fly IFR regardless of weather conditions. I discussed pushback requests in chapter 3. Pushback operations are ground crew related and as such pilots should not "request" a pushback from the gate or Jetway from the ground controller. They request this from the ground crew. The pilot only needs to request permission to start engines and taxi from the ground controller. If a commercial aircraft calls to request engine start then this alerts the ground controller that you are coming out of hibernation <grin> and getting ready to depart. They will understand if you're a commercial flight that pushing back is part of your getting underway. That is why the controller responded with "…cleared for engine start, ADVISE when ready to taxi." The ground controller only wants to know when you start moving around on their turf.

So the engine start went fine and all looks good. You call the ground controller and advise you are ready to taxi. The ground controller will clear the pilot to taxi to the active runway, providing the taxiway identifiers to reach the runway. Again the pilot must be ready with pencil and paper to copy the taxi instructions. At large airports there can be many taxiway identifiers given to reach the active runway. If the virtual pilot has the required airport diagram then the taxi operation can proceed smoothly.

Remember do NOT cross any runway unless cleared by the ground controller to do so!

Of course if you do not have the required airport diagram or just don't feel up to the challenge, then ask the ground controller for "progressive taxi instructions". The ground controller will be glad to provide the instructions to guide you right up to the hold short point.

Make sure to conduct any last minute checklist items such as turning on the landing lights, the transponder (including altitude reporting), strobe lights or any other items not completed either while taxiing up to the hold short point or while waiting for takeoff clearance. Be ready to takeoff when instructed as long delays after being cleared to takeoff will get the tower controllers special attention <grin>. Other aircraft may be approaching to land and delays getting airborne can cause problems for the tower controller.

Normally when you reach the hold short point you'll be instructed to contact the tower controller as follows:

Charlotte Tower N9COF holding short runway 23 ready for takeoff.

The tower controller will provide the pilot the current wind direction and speed and any other special advisories for the departure and clear the pilot for takeoff as follows:

N9COF Charlotte Tower wind 240 @ 8 with gusts to 12, caution a flock of birds near the threshold of runway 5, cleared for takeoff.

Note in this example the flock of birds are located on the opposite end of the runway the pilot is departing from, IMPORTANT TO KNOW! Even though the simulated pilot won't have to worry much about a bird strike I used this to make the point <grin>.

Once airborne the tower controller will hand off the pilot to the departure controller when appropriate as follows:

N9COF contact Charlotte Departure on 125.50 have a good flight.

The departure controller will be responsible for your transition to your primary route and altitude. If the pilot has loaded a SID into a navigational device then most likely you will have been cleared immediately after takeoff to "proceed as filed". This allows the pilot to kick in the autopilot under the guidance of the navigational device. If this is not the case then the controller may provide vectors to get the pilot headed in the right direction before releasing the pilot to conduct there own navigation. When the pilot reaches a point near 30 to 40 miles from the airport or an altitude nearing 18000 feet the departure controller will hand off the pilot to the first center controller. From there the flight progresses to the destination.

Let's back up slightly and review some of the finer points of planning a departure from an airport. Figure 303 depicts the flight plan departure route from KCLT at point A. Point B even though not in the example flight plan can be used to clarify a runway heading as long as the distance from the end of the departure runway is kept very short, say not more than approximately 5nm which is the extent of many airport zones. In this case an NDB, TRYON (CL) was chosen, approximately 4.8 miles from the end of runway 23. Here's a hint, all good pilots know that many NAVAIDs exist along a runway centerline to provide guidance during a landing. Well, why not use these to provide guidance during takeoff. Most clearances read "….on departure fly the runway heading…." So pick a fix, waypoint, or NAVAID to load into your navigational device to guide the aircraft just after takeoff along the runway heading (in other words the runway centerline).

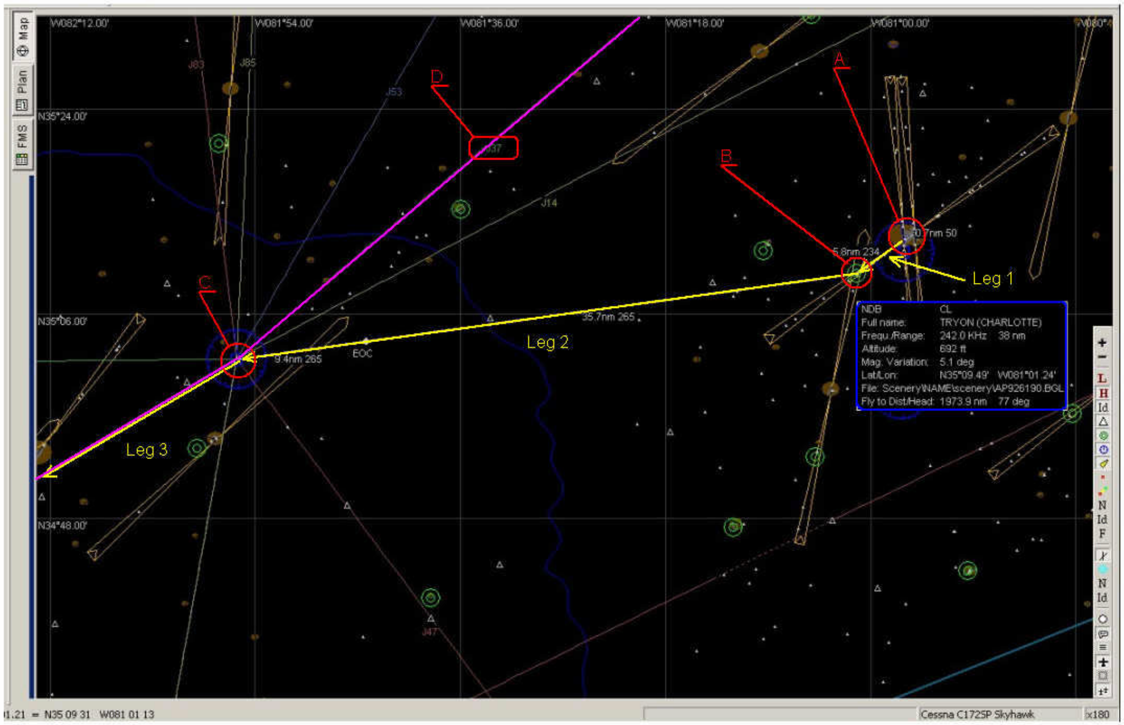


Figure 303 - Departure route from KCLT (A) to SPA VOR (C).

Jet airway J37 indicated by the label at point D comes down from the northeast until reaching point C, the Spartanburg (SPA) VOR then turns slightly right to continue on down to the southwest (toward Atlanta Hartsfield International). The pilot proceeds direct from point B to point C (the SPA VOR). At point C the pilot intercepts the en route airway to be used (J37) and proceeds on course to the southwest.

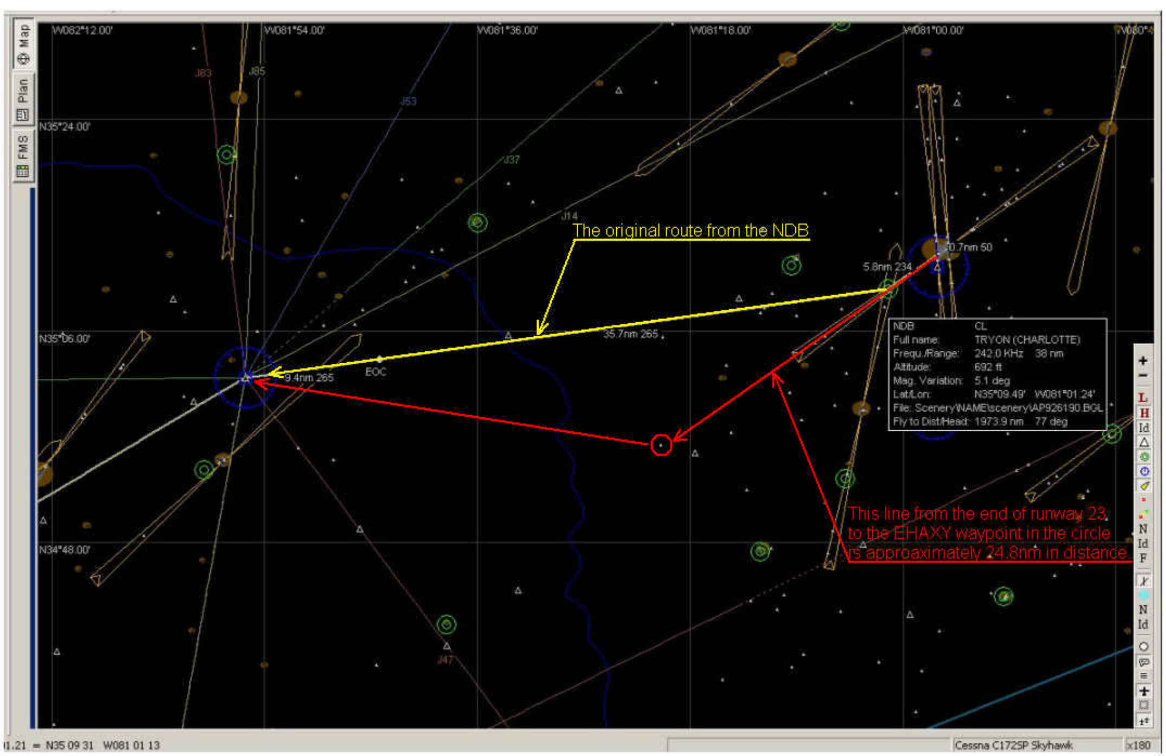


Figure 304 - Takeoff fix further out along the extended centerline of the departure RWY 23.

Remember, if you indicate in your flight strip (the flight plan sent to FSHost) these first few points this helps the tower and departure controllers immensely getting you efficiently underway.

If you choose to include a point further out (say more than 5 miles) such as depicted by the waypoint EHAXY, located exactly 24.8nm from the end of runway 23 inside the red circle depicted in figure 304, then you should include the fix in the flight plan as follows:

IFR N55LC CITATION KCLT FL190 **RWY23** **EHAXY** **SPA** J37 AJFEB RWY27R KATL KBNA

This would then become an "intermediate" fix between the departure airport (KCLT) and the first fix (SPA VOR) on the en route airway to be used. The original line of flight from the NDB is depicted in yellow. Always include any fixes required to identify routes that would otherwise be seen by the controller as a deviation from an expected flight path.

Once the pilot reaches the SPA VOR and turns on course following the airway the controller will most likely clear them to fly on their own navigation. The pilot should not stray from the airway centerline while conducting their own navigation. As mentioned if more than one airway is to be used (different airways) along the route then the intersection(s) connecting the airways should be included in the flight plan. For example, if a flight plan were to use not only J37 but also J39 then the fix at the point where the airways intersect should be used, in this case MGM VOR/DME located in Montgomery Alabama. It would look like this:

… SPA J37 **MGM** J39 …

The reason for including the intersection is so controllers can use FS Navigator search features to locate the fix quickly. If the pilot fails to place the fix for the intersection in the flight plan it can be time consuming to locate the intersection along airways that extend for hundreds of miles because there is no fix in which to do the search on. So the rule-of-thumb is always include the fix (intersection) connecting each indicated airway.

I mentioned earlier that when you put an airway into your flight plan that other fixes, waypoints, NAVAIDs, and such along a single airway should not be listed! Remember that controllers have the capability to display and identify these routes using FS Navigator. There are two types of airways, Low En route Airways commonly called Victor Airways and High En route Airways commonly called Jet Airways. Any extra fixes on the flight plan will only prove to complicate, confuse and frustrate the controllers, so keep it logical, and brief. Again include only fixes that connect airways, show distinct turns along an airway, or are the points where the flight gets on and off an airway such as in figure 303 at the SPA VOR NAVAID.

ARRIVING IFR AT A CONTROLLED AIRPORT

Okay, you have been handed off continuously from one center to the other and now you're reaching your destination, in this case, at a *controlled airport* (in the above example there is only one center, Atlanta). In chapter 3 I discussed airway charts and maps and some of the altitudes depicted on them such as minimum safe altitudes. At this point we need to review some points about *minimum safe altitudes*.

Terrain clearance during multiplayer activities won't always seem as crucial during takeoff (I guess because everyone climbs like a bat out of hell <grin> except maybe for smaller aircraft) but during *descent into the destination it will matter a bunch*. There will always be one controller that will take the trophy for being the mountaintop king/queen <LOL> because they don't use the proper charts or mind good rules of thumb leaving the pilot stuck like a bug to some granite slab of rock. *Landings, as always, are the most crucial part of a flight for the pilot*. During landings the aircraft is low and slow, approaching stall speeds. Add in weather, turbulence, and poor visibilities and handling the aircraft on a precision approach can turn into quite a challenge (there is nothing like being in a real aircraft on an ILS approach in stormy weather getting bounced around like a ping pong ball on an ILS approach…your hands will be sweating and your knuckles will turn white trying to handle the approach <grin>).

My best advice, *get the approach charts for the airports to be included in the online ATC activity* (at least for the airports and runways you expect to use) and use them (*that is both the virtual pilot AND controller*). Approach charts are just as good for controllers as they are for the pilot to supplement information provided by FS Navigator. FS Navigator sorely lacks good information on minimum safe altitudes (MSAs). Regardless, your experience during the multiplayer activity will be much better and more realistic. They will provide the proper minimum safe altitudes in the virtual world no matter what terrain mesh add-on is being used just as in the real world 99.9% of the time. Once you're use to reading them you can pick off the parts you need for virtual landings easily making the chances to goof up non-existent. If you don't have a clue about approach charts then don't sweat it; I'll be going over these approach charts in great detail within this chapter so hang tight, more to come. If you don't use the charts you will be guessing (*or using rules of thumb*) that will depend on both the controller and pilots knowledge of the simulated environment that may or may not work successfully (just like in the real world) and again, get to simulate that dreaded pucker factor <grin>.

Okay, let's pick up the arrival scenario where the pilot is with the last center controller. If you were cruising en route above 18000 feet MSL then the virtual controller is probably concerned about getting you down to approximately 18000 feet MSL to start with. Why? Because 18000 feet MSL is one of those altitudes where certain standards have been established, in this case it is the magic altitude where all pilots need to receive a current barometric setting from the controller so as to change it from the standard setting of 29.92 that all pilots are required to use while flying at or above 18000 feet MSL. When the pilot descends below 18000 feet MSL the virtual controller (and each one contacted thereafter) must remember to update the pilot with a current barometric reading. It isn't like it will change in the simulated environment but in some ATC services they may periodically update this during an activity to simulate the need to keep updated. We have talked about the dangers involved in chapter 3 if a pilot doesn't keep the altimeter set correctly in certain situations.

If the aircraft is below 18000 feet MSL then the next primary altitude of concern is 10000 feet MSL, this altitude of course is relative to the terrain altitude and could be higher. This magic altitude is where all pilots should reduce there indicated airspeed not to exceed 250 knots (unless cleared otherwise). It is the altitude where pilots (especially commercial pilots) should turn on their landing lights (see and be seen is the motto here). Other altitudes used by the virtual controller may be to clear terrain features or obstacles but these two altitudes, 18000 feet and 10000 feet MSL are key to the descent (actually the ascent too!).

The controller will probably try to get your aircraft down to 10000 feet AGL not later than 50nm out (*a rule of thumb again unless terrain avoidance makes that impossible say for instance Austria where some approaches have minimum safe altitudes above 10,000 feet MSL*). During the descent phase to the approach it is not unusual for a controller to allow the pilot to descend on there own discretion. Sometimes this comes with limitations such as a *crossing or altitude restriction (as we have previously discussed)*, so be sure to follow the controller's instructions. The controllers will understand the pilots need for a smooth descent regardless and strive to judge points where descents need to start to achieve this. If this descent point is not already generated by the controller's scope, some have calculators to produce a reasonable start point. *The pilots FMC may even generate this point (called the BOD – Beginning of Descent, or TOD – Top of Descent) and the pilot can request to start descent just by merely asking the controller when the FMC indicates it*. The center controller will hand off the pilot to the approach controller for *final transition to the initial approach fix* at or near 10,000 feet (terrain permitting) or the 50nm point again *as a rule of thumb*.

The approach controller during *initial contact* will normally advise the pilot which *active* runway to expect for landing at the destination airport. If the controller doesn't give you the expected active runway then ask them for it, *before* you must get busy with the approach! This allows the pilot to *prepare the cockpit radios* during descent for the instrument approach and landing. Doing it during the approach will prove to be a mistake as the pilot won't have time between flying the aircraft and following the controllers instructions. It doesn't hurt to review possible landing scenarios at the destination airport while still with the center controllers and your not to busy. Do not ask the center controller about the active approach to expect unless *absolutely* necessary as this is the approach controllers responsibility *at the time they get control of the aircraft*. Pilots using an FMC or GPS to control the aircraft can preload a runway approach and if it is *not* the one to be used *either change it on the fly or request the runway of choice* just after the approach controller has advised the pilot of the active runway to expect. *Unless it is an emergency* the controller makes the call on the runway used for landing. If you don't have a required frequency for the approach handy then ask the controller, their software (FS Navigator) allows them to *quickly look up frequencies*, just don't do it too often as *it is the pilot's responsibility to know the correct frequencies*, not the controller.

Okay, using our previous example the pilot will have flown the entire route via J37 and is reaching the destination at Atlanta Hartsfield International. Let's look at the flight plan components for the arrival into Atlanta.

Figure 305 - Looking at the arrival portion of a flight plan strip.

Earlier we jumped onto the airway at the SPA VOR. Here at AJFEB we'll jump off the airway and proceed direct to conduct a requested approach to runway 27R (if the controller doesn't decide otherwise). Chances are the controller won't have any objections because this works so smooth (and that is the idea right?).

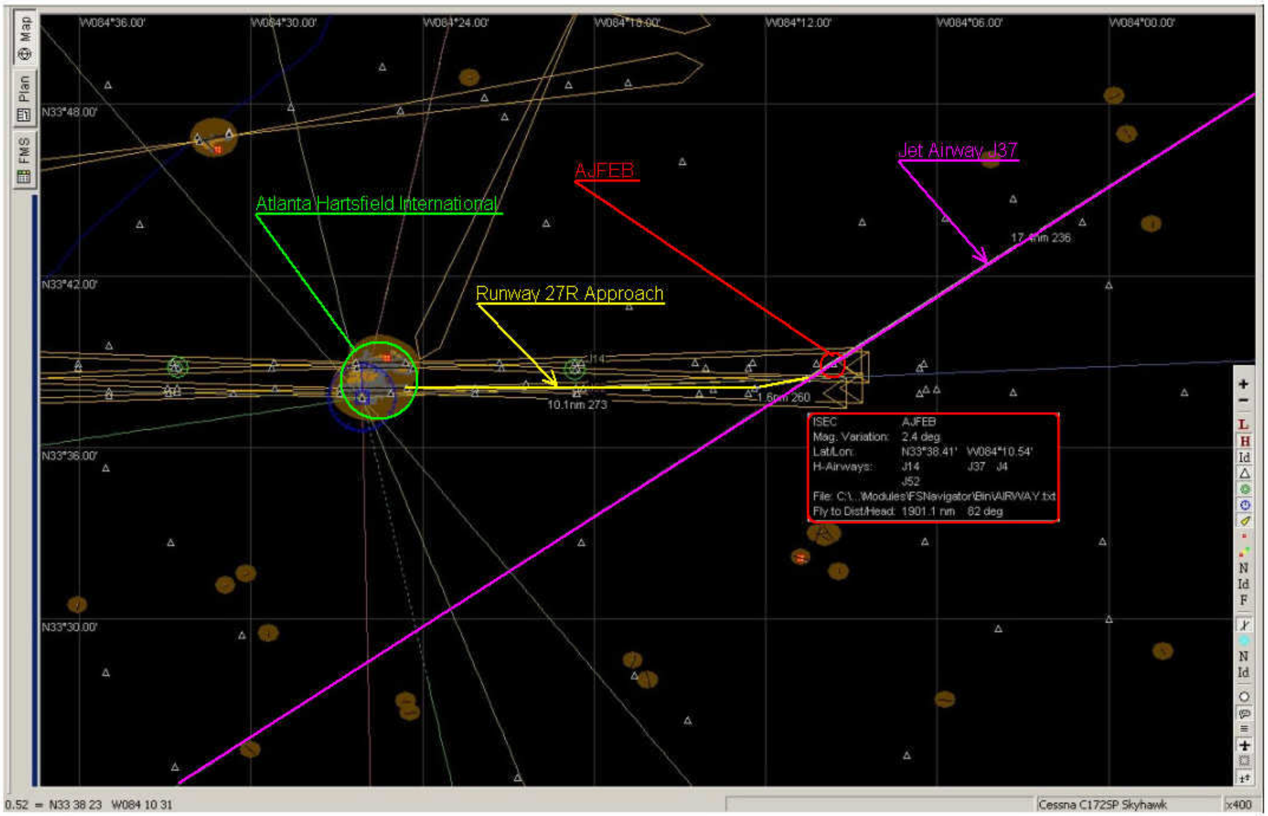


Figure 306 - Departure from the en route airway into the destination KATL.

Depending on the ATC service operational procedures it may be normal during the departure for the ground controller to consult the tower controller to determine the active runway for takeoff (the tower controller "owns" the airport runways). The ground controller then instructs the pilot which runway to taxi to. Here, during the arrival the approach controller will consult the tower controller to determine the active runway for landing and then vector the pilot for the approach. Some ATC services may allow the ground and approach controllers to make the call.

You can see J37 depicted via the purple line in figure 306. AJFEB is marked where the pilot will leave the airway. In this case the departure from the airway easily sets up the pilot for the runway 27R approach indicated by the yellow line. There is a fix used to depict the intercept of the approach centerline (or possibly the localizer for runway 27R depending on the approach conducted) and like the departure at KCLT this fix need not be entered on the flight plan as there is no major distance involved. Again, only provide intermediate fixes if required to get the aircraft from the en route airway to an initial approach fix (IAF) if a major distance is involved, that way the controller understands the route and not led to believe you are deviating off course.

Just before the pilot reaches the initial approach fix (IAF) the controller will either clear the pilot for the FULL approach via an initial approach fix or via vectors-to-final (VTF) just before reaching an initial approach fix. So what is the difference between a full approach and vectors to an approach?

Well first off, just so you know, full approaches will be a rare event at major airports with commercial air traffic. They are so busy that it is highly unusual for aircraft to be cleared to conduct full approaches around busy airports. Timing and sequencing require setting up aircraft like a "string of pearls" anywhere from 2 to 3 minutes apart (sometimes less at extremely busy airports). Full approaches are more common in a situation where the pilot is conducting the approach without available airport surveillance radar to monitor approaches such as at an uncontrolled airport. A center controller or final approach controller may be able to vector the pilot to reach an initial approach fix but from there the pilot conducts the approach on their own using the published approach procedure.

Hence the difference; a full approach is one where the pilot must perform specific maneuvers to ensure proper acquisition of the final approach course on their own using established procedures provided on the approach charts. The full approach almost always involves completing a procedure turn or entering an approach holding pattern, again to get the aircraft headed inbound on the final approach course. The flight simulator GPS will do this for you easily if you have read up on how to properly load an instrument approach into the GPS, reference chapter 3 under the section about "Navigation by GPS". Remember, the GPS will not handle vertical (altitude) navigation; only lateral (path) navigation.

The vectors-to-final rarely ever involves a procedure turn or approach entry holding pattern (even though the controller might provide vectors that do something similar) to get established on the final approach course because the controller is doing the work for you via radar. This is why controllers are required to ensure the aircraft intercepts the final approach course from the left or right of the centerline at 30° or less. This allows for the navigational equipment coupled to the autopilot to properly manage the approach without extreme maneuvers. The GPS always allows the pilot to load an approach "ready to activate" as soon as the controller provides final clearance to conduct the approach after vectors-to-final or at the start of a full approach. Since the pilot is not required to perform the procedure turn or entry holding pattern during a vectors-to-final approach the GPS compensates for this by not showing a procedure turn or entry holding pattern on the GPS as part of the approach.

The same applies when completing instrument approaches at non-towered (uncontrolled) airports. An Approach controller can guide the pilot via vectors-to-final to conduct either a full approach on their own or to conduct a no procedure turn approach from an IAF.

By definition a vector is a heading issued to an aircraft to provide navigational guidance by radar, *either way the pilot should always have the appropriate approach chart for the instrument approach to be conducted*. Most of the time controllers want to be advised by the pilot when they are established on the localizer (by definition the localizer is the component of an ILS which provides course guidance to the runway) and at that point typically provide the pilot final clearance to complete the approach on their own. ***This approach clearance is not a clearance to land; only the tower controller can issue the landing clearance!***

If the controller provides the pilot vectors-to-final for a direct intercept of the localizer then the controller retains partial responsibility to ensure proper guidance and altitudes for the pilot to a point allowing the pilot to smoothly intercept the approach path at safe altitudes, typically a point (during a multiplayer activity) approximately 15+nm out approaching the center line of the assigned runway at an angle not greater than 30° either side of the centerline at a minimum safe altitude.

Again it is pertinent to remember some important points. FAR 91.123a states that *when an ATC clearance has been obtained, no pilot in command may deviate from that clearance unless an amended clearance is obtained, an emergency exists, or the deviation is in response to a traffic alert and collision avoidance system resolution advisory. However, except while within Class A airspace, a pilot may cancel an IFR flight plan if the operation is being conducted in VFR weather conditions. When a pilot is uncertain of an ATC clearance, that pilot shall immediately request clarification from ATC* but let me continue with FAR 91.3a which states *the pilot in command of an aircraft is directly responsible for, and is the final authority as to, the operation of the aircraft*.

If the aircraft enters a condition of emergency (FAR 91.3b which states *in an in-flight emergency requiring immediate action, the pilot in command may deviate from any rule of this part to the extent required to meet that emergency*) in other words the pilot can demand or do just about anything s/he wishes but must not forget that FAR 91.3c states *each pilot in command who deviates from a rule under paragraph (b) of this section shall, upon the request of the Administrator, send a written* *report of that deviation to the Administrator*. This puts a heavy burden on the pilot's judgment if s/he lives to tell the tale and doesn't want their license put through the shredder. In the virtual world you may have to answer to the lead controller as to why you performed specific actions (declared during emergency maneuvers) during a multiplayer event!

The intent in reviewing the above definitions is so there is an understanding of pilot/controller responsibilities during this critical phase of flight, the landing approach. The FAR/AIM manual states that there is an intentional overlap of pilot and controller responsibilities to effect better safety. I dig into this topic in chapter 7. So it should be in the virtual world, but bottom line the pilot assumes final and ultimate authority for the safe conduct of the aircraft and if required *the pilot is responsible to request an amended clearance if ATC issues a clearance that would cause a pilot to deviate from a rule or regulation, or in the pilot's opinion, would place the aircraft in jeopardy*.

Once on the localizer the approach controller will normally clear the pilot to finish the approach on their own typically with the restriction not to descend below the minimum glide slope intercept altitude found on the appropriate approach chart if conducting an ILS approach. By definition the glide slope intercept altitude is *the minimum altitude to intercept the glide slope/path on a precision approach. The intersection of the published intercept altitude with the glide slope/path, designated on Government charts by the lightning bolt symbol, is the precision FAF; however, when the approach chart shows an alternative lower glide slope intercept altitude, and ATC directs a lower altitude, the resultant lower intercept position is then the FAF*. FAF stands for Final Approach Fix, reference figure 307.

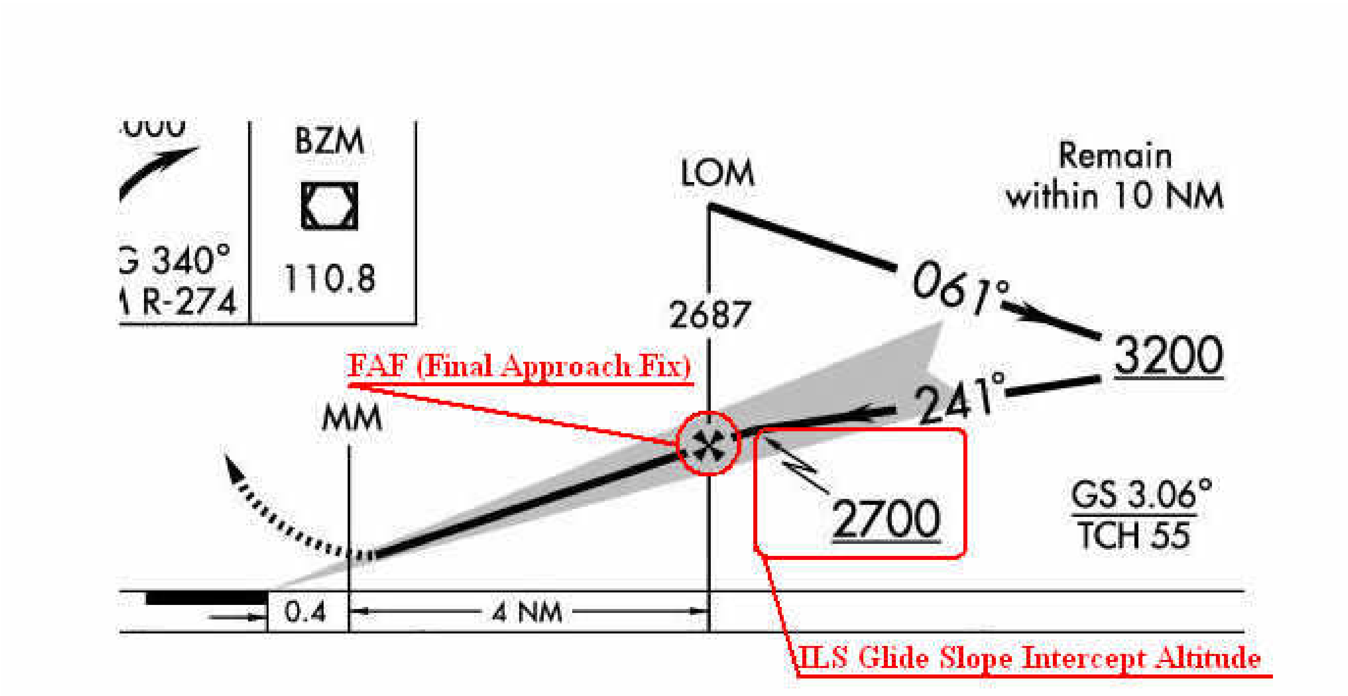


Figure 307 - The final approach fix (FAF) and glide slope intercept altitude.

At this point (before reaching the FAF) the pilot should have the aircraft stabilized flying level at the glide slope intercept altitude fully prepared for the final descent to the runway (gear extended, flaps as required, controls trimmed, etc…). Somewhere just before the FAF the approach controller will handoff the pilot to the tower controller.

The tower controller typically provides the pilot a final barometric setting for the altimeter (again, very important so the pilot can reference the correct decision height in MSL), the current wind direction and speed, and visibility for landing. It would not be unusual for the tower controller to include a reminder for the pilot about having the wheels down and locked (wouldn't be the first time a virtual pilot threw a few sparks screeching down the runway <grin>).

The most important thing a tower controller does for the landing pilot is to clear them for the landing. Let's put some emphasis on this, *a pilot is **not** allowed to land unless they receive the final landing clearance* from the tower controller, *otherwise they **must** execute a missed approach*. Even if the tower controller just flat out forgets (heaven forbid) the pilot can not land. *Remember, the tower controller "owns" the runway(s)*, so do not get on that runway unless cleared. It may be an aircraft is crossing the runway; maybe an animal has strayed onto the runway, maybe another aircraft blew a tire during landing and stopped on the runway, ***if you don't get the landing clearance then DON'T LAND!***

After landing the tower controller will advise the pilot to exit the runway (either left or right) and handoff the pilot to the ground controller. The ground controller will then provide instructions for the pilot to taxi to parking. If requested the controller will provide *progressive taxi instructions* to the pilot. If you have a smart ground controller they will know the type aircraft via the flight plan (*or ask the pilot to say what type aircraft they are in*) and direct them to the ***proper*** virtual parking area such as general aviation (GA) for private aircraft, the cargo ramp for cargo aircraft, or the terminal with jet ways for commercial aircraft. It doesn't make any sense to have a Cessna 172 pull up to a jet way <grin>.

If the controller tells the pilot to taxi to parking of their choice and advise them when shutting down the engines, then it is up to the pilot to park appropriately and tell the controller when shutting off the engine(s). This may be done for a number of reasons but primarily it would be due to the lack of scenery details and the controller has no way to provide detailed taxi instructions via taxiway signs and markings. If you still need help getting to parking then just ask and most controllers will normally help as best possible using standard clock points to guide you in the right direction.

IFR FLIGHT FROM AND TO UNCONTROLLED AIRPORTS

Now let's step into a different scenario, one where the pilot steps back in time, a time where airports did not have much of anything much less ATC. Modern navigation aids were not yet present. Pilots had to use *dead reckoning* for navigation, with no more than a compass and timer to lead them to their destination and nothing to aid their landing once there. Weather was an enemy and parachutes were a friend. So how did they get in and out of such airports? Well, they didn't and many that tried have R.I.P. written all over them. Many tragedies tread the way for safer methods of flight. Just as in that time we still have many uncontrolled and remote located airports all over the world but there is a difference, today pilots, aircraft, and airports have modern aircraft instrumentation, training, navigation aids, and well documented departure and arrival procedures to get them from and to airports of their choice safely even in the worst of weather. Today pilots can depart and arrive from even the smallest uncontrolled airports under IFR rules with little or no ATC with confidence using these modern instruments and procedures on their own if available. In this section we'll discuss the basic procedures a virtual pilot simulates to depart and arrive at *uncontrolled airports*. IFR departures and arrivals at uncontrolled airports share many procedures between VFR and IFR operations as discussed. The VFR aspects pertain primarily to the communications used at uncontrolled airports whereas the IFR aspects pertain primarily to procedures to conduct the approach as done at controlled airports. You'll see how ATC aids the pilot to start the approach at an uncontrolled airport, allows them to switch to a local advisory frequency at the airport to make radio calls *in the blind* to report their position and intentions just as a VFR pilot would do, and stands by to again be contacted by the pilot due to a missed approach if the pilot is unable to complete the landing. These scenarios are less popular during live ATC activities only because they are the least understood, but with knowledge and practice this can become an additional experience to online IFR flights. These are good for the virtual controller also <grin>, keeping them on their toes. Learning something typically isn't going to be successful unless you try it (several times at that), and in the virtual world it never hurts to try <grin>!

DEPARTING IFR FROM AN UNCONTROLLED AIRPORT

When departing from uncontrolled airports things change because there is no active local ATC such as ground or tower controllers to provide safe movement and separation of aircraft. *The pilot assumes full responsibility for safe operation of their aircraft and providing the necessary radio calls* ***in the blind*** *on an appropriate frequency to make other pilots aware of their movements and intentions.* Just as when departing from a controlled airport if the weather is below VFR flight minimums as previously discussed and before the pilot starts the engine(s) and makes for the active runway s/he must file an IFR flight plan. Here there are some minor differences than what occurs when departing a controlled (towered) airport.

In real-life the pilot files an IFR flight plan with ATC at an uncontrolled airport by a remote radio receiver/transmitter on the airport or via a telephone. During multiplayer activities you'll file your flight plans using the chat window in the flight simulator when connected to the multiplayer server (FSHost) as you would at a controlled airport (nothing different about that), then you will call the controller labeled ATC1 on TeamSpeak addressing them as Flight Service (this is the ATC1 controllers first clue that you are probably at an uncontrolled airport) to request and obtain an approved clearance before departure. Here things change a bit.

The controller will read a clearance that is similar to this:

N9COF is cleared as filed to the destination airport. Climb and maintain 5000 feet, expect flight level 210 one zero minutes after departure. Squawk 4453 and contact Atlanta Center on 125.25 to activate your flight plan. If not activated within 30 minutes the flight plan is canceled.

Note that the controller will provide your clearance with an initial climb altitude just like IFR pilot's departing controlled airports. No "fly runway heading" is required here as the pilot will be responsible for the initial flight direction after takeoff (because they will not be under positive ATC control just yet). They will provide a squawk code for you to transmit after going airborne and provide the frequency for you to contact ATC on to activate your flight plan, usually the center that is responsible for the area where the airport is located (if you wish to know which center you would call to and how to address them when activating your flight plan it will be part of the information on the approach charts for the airport you are departing). *A major difference is that this approved clearance has a time limit!* ATC is giving you 30 minutes from the time you get the approved clearance to get into your aircraft, get it fired up, taxi to the runway, and get airborne otherwise the deal is off <grin>! There are many reasons for the time limit, sequencing of departing and arriving aircraft, en route sequencing and on and on. Primarily this is YOUR time slot to depart that airport (they have checked the system to see if any other aircraft is due to takeoff or land during that time slot). So typically the real-life pilot has the aircraft checked out and ready to go by the time they call to get their clearance (this would not be a good time to run into delays) otherwise you'll be calling them back, but wait there is more to this story.

Let's back up again slightly at the point when the pilot does climb into the aircraft to depart. The first thing that must happen after the engine(s) are started is the pilot must tune the COM radio to the appropriate CTAF frequency listed for the airport (*this is typically a common UNICOM frequency as previously described under the section about Controlled and Uncontrolled Airports*). Each online ATC service should provide for such a common frequency on the communications server to allow virtual pilots to simulate making their *blind calls* just like at a real airport.

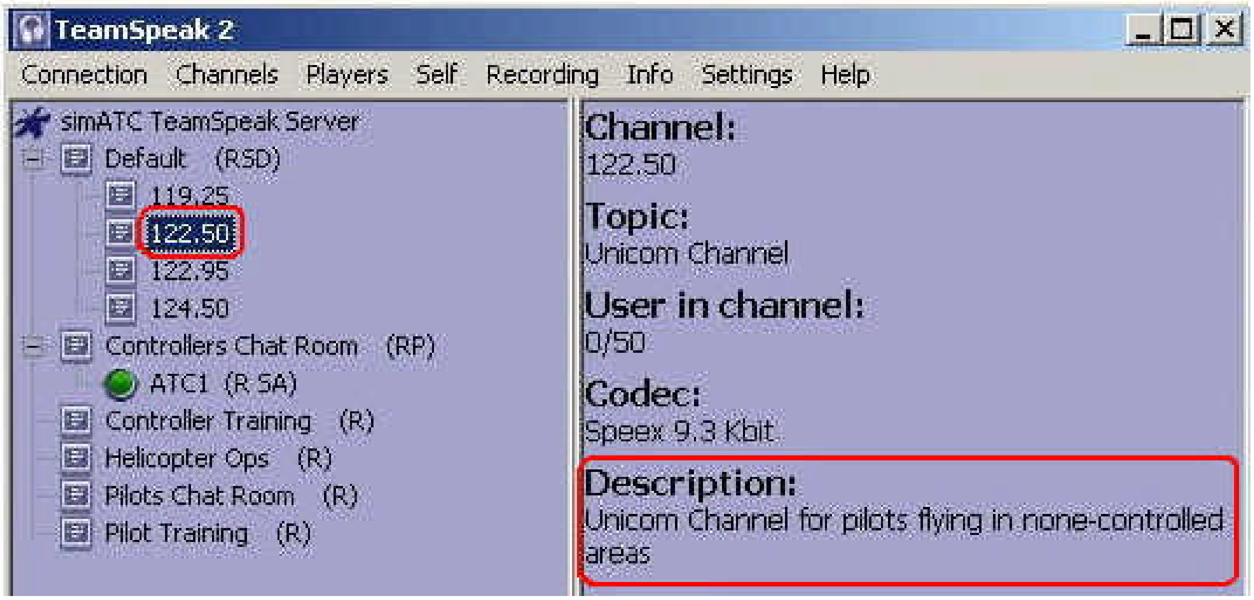


Figure 308 - Unicom (or CTAF) frequency provided on TeamSpeak.

The pilot makes a call *in the blind* on the CTAF frequency stating their intention to taxi for departure (*just like calling the ground controller at a controlled airport BEFORE moving the aircraft*), the runway that will be used for takeoff (*similar to the tower function*) and the general direction of departure using typical compass points such as N, E, S, or W from the airport (*similar to the departure controller function at a controlled airport*). All these are done solely by the pilot so others will understand their movements and intentions.

Another important issue for the pilot is runway selection for the departure. Since there is no controller to provide wind direction or speed how does the virtual pilot choose the proper runway before takeoff at an uncontrolled airport? Well let's discuss how the real pilot does it. In real-life the pilot may have several options, they might listen to a local automated ATIS broadcast, they may look at the airport wind sock (*you know that striped looking sock that Dr. Seuss left hanging on a pole <grin>*),

Figure 309 - The wind sock!

or it may be provided by an FBO (*Fixed Base Operator*…remember that's the folks that work at the uncontrolled airport providing fuel, parking and other basic services to the pilot) who may have a wind and barometric gauge to allow them to provide the current readings to a departing or arriving aircraft via a base station radio and the common CTAF channel.

For the virtual pilot the ATC service will prescribe how they post ATIS information but one of the easiest methods is by posting it on TeamSpeak in the description block for the ATC1 controller frequency, reference figure 310.

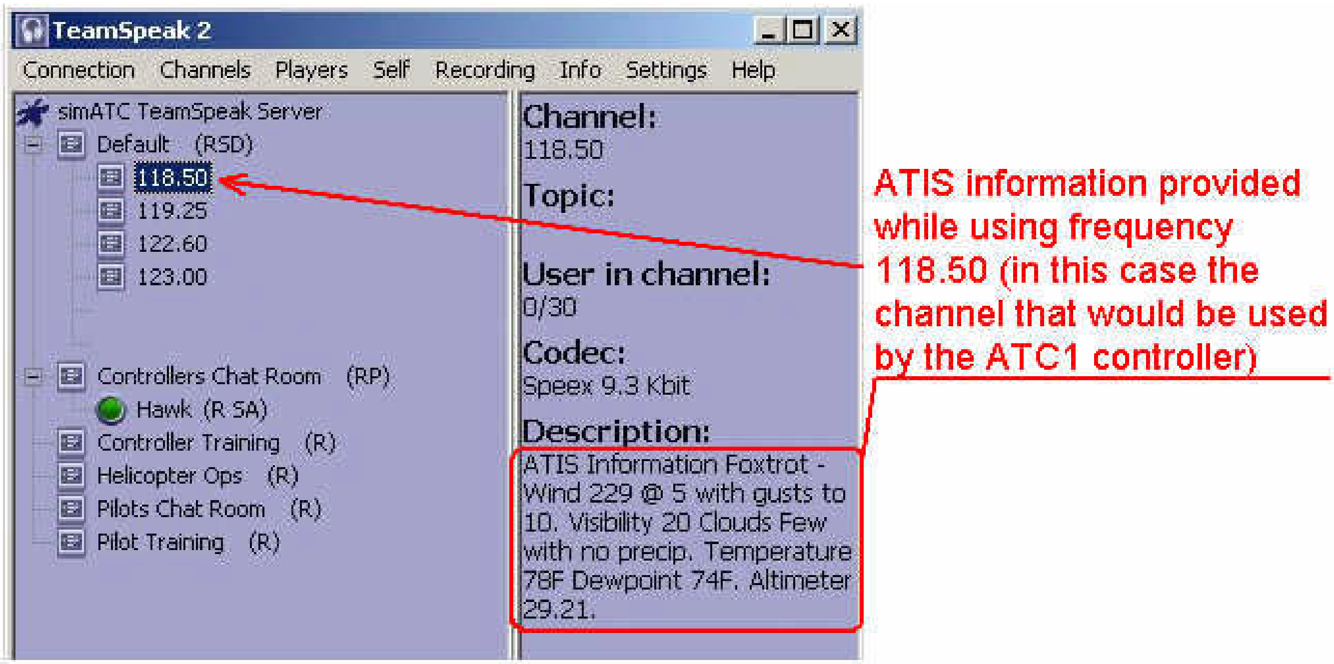


Figure 310 - ATIS info posted in the channel used for ATC1 during multiplayer activities.

What about the altimeter? I discussed these in chapter 3 but I'll review this quickly here. In real-life when departing or arriving at controlled airports the controllers can conveniently provide a calibrated and accurate altimeter reading. The same is true in the virtual world; controllers will provide the current altimeter setting provided by the host server. Typically the host barometric setting is also part of the posted ATIS information as in figure 310 if properly updated (careful, the posted ATIS information in TeamSpeak is not automatic but manually updated, be sure it is current). In real-life the local automated ATIS would also provide a local barometric reading but WHAT IF a barometric reading were not available (*what if the current altimeter setting were not posted as part of the virtual ATIS information?*), how would the pilot handle this?

Well first, let's discuss some real-life aspects to obtain a general understanding of altimeters. Altimeters are normally a mechanical device which reads atmospheric pressure. The accuracy of altimeters is affected by four general factors.

5. Nonstandard temperatures of the atmosphere.
6. Nonstandard atmospheric pressure.
7. Aircraft static pressure systems (position error)
8. Instrument error.

So, in the virtual world we will be subject primarily to the simulated properties of number 1 and 2. I assume 3 and 4 will be totally accurate in the modeled aircraft used for the flight. The host server administrators (controllers) *can change the first two properties*, but if the settings *are not changed* then the cautions I'll point out here are mute. If the host weather settings are changed periodically or are based on real-time real-world weather then the cautions are very applicable, especially if your flight simulator configuration is set to have the altimeter manually updated.

So what cautions I'm I speaking of? Well if the settings are changed from high temperatures and pressures and set to extremely low temperatures and pressures towards the end of a flight then virtual pilots like real-life pilots need to exercise extreme caution when flying in proximity to obstructions or terrain if they do NOT obtain a current altimeter reading. This is especially true in extremely cold temperatures; this situation can cause serious errors that result in the aircraft being significantly lower than the indicated altitude (if the altimeter barometric setting is not updated).

There is a motto associated with flying from a high to low pressure area which states "going from high to low look out below". In other words if the atmospheric pressure is dropping along the route of flight and the pilot disregards obtaining current barometric readings to properly set the altimeter the aircraft will eventually be lower than what is actually reported on the altimeter gauge. This of course is bad possibly exposing the aircraft to striking obstructions or terrain, hence the reason for receiving current barometric readings from each initial contact with a controller when the aircraft is flying below 18000 feet MSL along the flight route.

Remember, every pilot flying at or above 18000 feet MSL dials in the standard sea level pressure of 29.92. Adoption of this standard altimeter setting at the higher altitudes eliminates station barometric errors, some altimeter instrument errors, and errors caused by altimeter settings derived from different geographical sources.

The barometric setting pilots dial into the Kollsman window on the altimeter (*the Kollsman window is named for Paul Kollsman, who invented the first accurate altimeter*) is a product of measuring atmospheric pressure via inches of mercury. It is known that as altitude increases every 1000 feet that the measurement changes by one inch of mercury. For example, if you are at a sea level airport with an atmospheric pressure of 29.92 (standard sea level pressure barring pressure changes due to weather systems or temperature) if you climb 1000 feet the measurement would be 28.92. If you were to climb 2000 feet the measurement would be 27.92 and so on. Using this known standard it can also be said that for every inch of error input into the Kollsman window you will get 1,000 feet of error in the altimeter reading (bad karma!). So it is very critical for pilots to accurately input the altimeter reading as given, a 1,000 foot error, especially while flying in a general aviation aircraft over mountainous areas can really make ones day (general aviation aircraft typically can not fly over higher mountains with a better margin of safety as jet aircraft can).

For more information about altimeters reference *Chapter 7 Section 2 "Altimeter Setting Procedures"* in the AIM which spell out many things about altimeters.

So now, let's get back to more of the virtual procedures since we know more about what we are dealing with. *At uncontrolled airports where an altimeter reading is unavailable the pilot must turn the altimeter dial to make it properly read the airport altitude as published in appropriate airport charts before takeoff*. Then if you read the setting in the Kollsman window it will show you the local barometric pressure setting as long as the altimeter is working correctly.

As a matter-of-fact if a controller were to provide a real-life pilot an altimeter reading (which is suppose to be calibrated and accurate) while parked on the airport ramp and you set that reading into the Kollsman window, the altimeter altitude should be less than plus or minus 75 feet of the published airport altitude. If not then the altimeter accuracy should be considered questionable and should be evaluated by an appropriate repair station. Hopefully all virtual altimeters are working properly <grin>!

Later, after takeoff from the uncontrolled airport when contacting the appropriate center controller to activate your IFR flight plan, the controller will provide the current barometric setting for the altimeter. There after each subsequent controller along your route will do the same if your altitude remains below 18000 feet MSL.

Okay, now let’s taxi to the runway of choice and when the pilot reaches the runway *hold short point* they stop the aircraft. At this point the pilot takes the time to examine for other departing or arriving aircraft (weather permitting).

No matter what the wind direction look at both ends of the runway. Pilots don’t have to land into the wind (at least not some I know <grin>). If the wind is calm they could choose any runway, so look at ALL of them especially if your airport happens to be an uncontrolled multi-runway airport. Be sure to check down the runway to be used and ensure no other aircraft is preparing to position for takeoff on the far end.

One last note about uncontrolled airport runways, since most are typically smaller airports they tend not to have separate taxiways due to construction expense to reach each end of the runway(s). This then requires the pilot to typically taxi onto the runway and “back taxi” to the end and turn around on the runway itself to position for takeoff. Not a problem but don’t linger on the runway any longer than required.

So BEFORE finally taking to the runway you have stopped, looked and what else, listened right? So what are you listening for? Well, BEFORE you stick your nose onto the runway make that call on the CTAF channel to let others know you are getting on the runway to takeoff (especially if there is obscuring weather). Then LISTEN! The pilot should pause briefly for any pilot to respond on the radio before taxing onto the runway for departure.

Once the pilot is on the runway and getting ready to roll the pilot makes a call to let others know they are taking off from the runway. After the pilot is off the runway and airborne the pilot makes the final call to advise others they’re leaving the airport area and provides his or her current altitude and direction of flight away from the airport.

It is up to the pilot to determine when they have safely exited the airport traffic area (typically 5nm at or above 3000 feet AGL) and discontinue advisories on the CTAF frequency. Depending on active aircraft in the area you may want to extend your time listening to the frequency just before contacting ATC to activate your IFR flight plan time permitting (in this example *don’t forget the 30 minute time limit on activating your flight plan*).

As soon as the pilot is done on the CTAF frequency and reached any required minimum altitude for radio contact s/he will immediately contact the appropriate controller (*normally the center controller for the area of departure or as indicated in the clearance*) to activate the IFR flight plan filed.

During online ATC activities you’ll switch from the provided CTAF frequency to the appropriate controller for your initial contact (probably the ATC1 controller) or per the ATC service guidelines you’re using and activate your flight plan. When you contact the controller you state your aircraft ID, airport of departure, current altitude and altitude you’re climbing to (*the initial altitude they assigned in your clearance*), your direction of flight and that you wish to activate your IFR flight plan similar as follows:

Atlanta Center N9COF off at Wilkes County airport climbing through 3000 feet for 5000 heading 200 degrees requesting activation of IFR clearance.

The center controller will establish radar contact with the aircraft first as follows:

N9COF roger ident.

Remember, ident means to push the little button on the transponder to make your aircraft radar blip light up bright so the controller can easily spot you on the scope, simulated of course here by a brief pause (you can confirm the ident if you wish <grin>). Actually the virtual controller will ensure your blip shows up on FS Navigator as part of the activity.

N9COF radar contact, continue your climb to flight level 210 and proceed on course as filed.

Your clearance is now activated. The controller will now accomplish the same duties as performed by the departure controller at a tower controlled airport providing further vectors as required or clearing you from your present position as filed (as in the example) to your intended airway. From there the pilot is under positive ATC control and continues the flight as any IFR pilot using the communications described for controlled airports in previous sections.

ARRIVING IFR AT AN UNCONTROLLED AIRPORT

When arriving at *uncontrolled airports* the current center controller will start the pilot on a descent to handoff the aircraft to the appropriate controller (who will act as your approach controller) for the destination airport just as they would for a controlled airport.

The name used for the approach controller is not normally the name of the destination airport (*remember the uncontrolled airport doesn't have any local controllers*), but rather it will typically be the name of a nearby major airport approach control that handles the uncontrolled airport within their area of responsibility. This is a common mistake of ATC service controllers because it is easier to just name the approach controller the same as the destination airport. Regardless use the method your ATC service prescribes.

In the real world major airport approach controllers typically have control of various airports within close proximity to their airport; some do it over great distances via remote radars. Sometimes it is a center controller who handles the approach. The center controllers will handoff to one of these approach controllers for arrivals at uncontrolled airports but remember, *this approach controller does not have a tower to handoff the pilot to at the uncontrolled destination airport*. The approach controller will use the same procedures as conducted at a controlled airport to guide the pilot to a proper intercept of the appropriate approach and provide safe minimum altitudes and then provide a clearance to the pilot to conduct the approach on their own and advise them to switch to an appropriate CTAF frequency at the airport to make the necessary radio calls in the blind. The pilot will also be advised to report back with this approach controller if the landing is unsuccessful to execute a missed approach.

It is understood and automatically implied that "radar service is terminated" when switching to the local CTAF frequency. Think about this, when the pilot switches to the CTAF frequency to make the *blind calls* at the uncontrolled airport they are not in direct contact with the controller and the controller can not provide radar services, the pilot is literally on their own. Make sure to follow the approach procedures precisely as published and to make all required calls on the CTAF frequency to make other aircraft in the air and on the ground aware of your presence, position, and intentions just like during takeoffs from the uncontrolled airport or like a VFR pilot at an uncontrolled airport.

Now common sense tells you that during IFR conditions air traffic should be limited to IFR flights *because VFR pilots are grounded due to the weather*. Also no aircraft should be taking off from the airport at the same time as you are landing if ATC has coordinated things properly? Regardless, make the calls as if your life depended on it, safety first!

I mentioned the approach controller will advise the pilot *before* releasing them to switch to the CTAF frequency to *report back on the same frequency* if a missed approach is executed (*due to not landing for whatever reason*). From there you'll state your intentions and either try the approach again or proceed to your alternate airport as required. If the landing is completed successfully and after the aircraft is parked the pilot must not forget to cancel the flight plan by calling ATC via a telephone or radio (*you simulate this by calling the approach controller on the same frequency you were told to report back on but instead of declaring a missed approach you tell them you have landed safely and would like to cancel your IFR flight plan*).

Now let's back up just a bit as if the pilot did not land and executed a missed approach instead. What is the first step? Well, the pilot must immediately get the aircraft climbing on the runway heading following the published missed approach procedures per their approach chart (*don't forget the missed approach always starts at the MAP and not before*) THEN *declare the missed approach on the CTAF frequency*. Once the pilot is safely conducting the missed approach they can then switch back over to the approach controller as instructed and declare the missed approach with them stating their intentions to try the approach again or divert to the alternate airport.

It is not unusual to try an approach more than once and catch a "break" in the weather that might allow a safe landing. The weather sometimes can change enough so that when you come around again on another approach that visibilities allow a proper and safe landing. In real-life if the weather is below minimums the pilot may have to divert to an alternate airport. By definition an alternate airport is defined as *an airport at which an aircraft may land if a landing at the intended airport becomes inadvisable* but FAR 91.169 provides for certain criteria to be met to use an airport as an alternate. Again there is more real-life criteria then what is necessary in the virtual world but using the FAR as a baseline we can set a rule of thumb that *if the visibility will be 2 miles or greater and a ceiling of 800 feet or greater at the estimated time of arrival then the airport can be used as an alternate* (as always check with the ATC service being used to find out what they prescribe). Most virtual pilots capable of conducting an ILS or non-precision approach can easily deal with such a visibility and ceiling. Someone may be asking "but how do you simulate this?" Well, it can be done manually by the controllers selecting the proper settings within FSHost. If real-world and real-time weather are being used (FSHost does not have this capability I know of to date) the only way to determine an alternate would be via TAF (Terminal Area Forecast). If controllers are properly trained challenging scenarios can be arranged.

Also during flight planning real pilots are required to follow *FAR 91.167 Fuel Requirements for Flight in IFR Conditions*. For virtual purposes this would be *enough fuel to fly from the departure airport to the destination airport then from the destination airport to the alternate, and then fly after that for 45 minutes at normal cruising speed*. So be prepared for the worst case scenario.

Uncontrolled airports are typically smaller airports and may not necessarily be equipped for ILS landings (*a Precision Approach system*) due to the cost of such equipment. Most uncontrolled airports will be equipped with older, simpler, and cheaper NDB (Non-directional Beacon) transmitters, a *Non-Precision* instrument approach system, to guide pilots to the runway. The difference between precision and non-precision approaches is that non-precision approaches lack the electronic glide slope present in a precision approach system.

Of course an NDB approach being more basic means more work for the pilot and it does not provide the accuracy to reach the runway threshold as does the ILS approach so pilots must be more careful conducting the NDB approach. Factor in winds and the NDB approach becomes quite a challenge due to aircraft drift. Pilots conducting an NDB approach *must* understand how to properly compensate for aircraft drift during an approach.

VOR (Variable Omni-range) approaches are also a non-precision approach due to the lack of a glide slope but are more accurate and safe concerning lateral guidance than the NDB because the pilot doesn't have to worry about aircraft drift if properly tracking the VOR "radial". Some VOR transmitters can tell you the distance from the transmitter via DME (Distance Measuring Equipment) providing for even greater accuracy concerning the exact location of the aircraft along the approach path. DME measurements make it easy to establish altitude step down points along the approach path to get pilots to a predetermined safe minimum altitude.

Finally there is the newest technology called GPS (Global Positioning System) that allows for very accurate positioning of the aircraft via satellite signals and even some altitude information. I'll describe each of these shortly within this chapter.

NDB, VOR, and GPS approach procedures (*all non-precision approaches*) provide for safe “step down” altitudes at specific fixes along the approach to keep aircraft and soles on board safe. The goal is to reach a final “step down” altitude the pilot *must not descend below* until acquiring the runway environment visually and maintain visual contact to a safe landing. If the pilot doesn’t acquire the runway environment by the time they reach the MAP then a missed approach must be executed.

So it is important to note that the ILS (Instrument Landing System) is the most preferred system due to the accuracy and safety it provides getting an aircraft down to the runway safely even in worst case visibilities. So, bottom line, if an airport has a working ILS use it.

IFR CHARTS AND SYMBOLS

A prerequisite to understanding and learning instrument approaches is the art of reading and understanding instrument approach charts (also referred to as instrument approach plates). In this section I’ll spend some time to show you where to obtain instrument approach charts for any U.S. airport (freely available), how to make high quality printouts for those you wish to use, how to read the charts, and understand the information provided on them. Once you are armed with this skill we can dive head-on into discussions about precision and non-precision approaches. I’ll cover Instrument Landing Systems (ILS), Ground Controlled Approaches (GCA), Localizer (LOC), Localizer Back Course (LOC BC), Variable Omni-Range (VOR), Non-Directional Beacon (NDB), and Global Positioning System (GPS) type approaches in detail. This will include a discussion about Standard Instrument Departures (SIDs) also referred to now simply as Departure Procedures (DPs) and Standard Instrument Arrival Routes (STARs). These charts can have a positive impact on your abilities and provide a much richer experience when participating in online ATC activities.

ADOBE ACROBAT AND READER

Many commercial applications exist today to allow companies and government agencies to efficiently convert written documents and graphical images into special formats that include copy/print protections, compression, and so on. These packages themselves cost hundreds of dollars but once the documents are saved in their native formats then all that is required for users to view them is a “reader” application. The U.S. government widely uses an application called Adobe Acrobat to save hundreds and thousands of documents in PDF format. Many aviation maps, charts, and manuals are stored in this format and this is true for the charts we’ll use in the following sections to discuss instrument approaches. So I highly recommend downloading the Adobe Reader (freely available) not only for use here but for your own private use as well. Many other documents available on the Internet are stored in PDF format. Once you have the software loaded on your computer, if you do download such a PDF document the application will automatically open it by association. So let me give you the link (as of this writing) where you can find the current version of the Adobe Reader.

http://www.adobe.com/products/acrobat/readstep2.html

When you click on the link above you’ll be taken to a web page and on that page will be a button to click on labeled “Continue” reference figure 311.

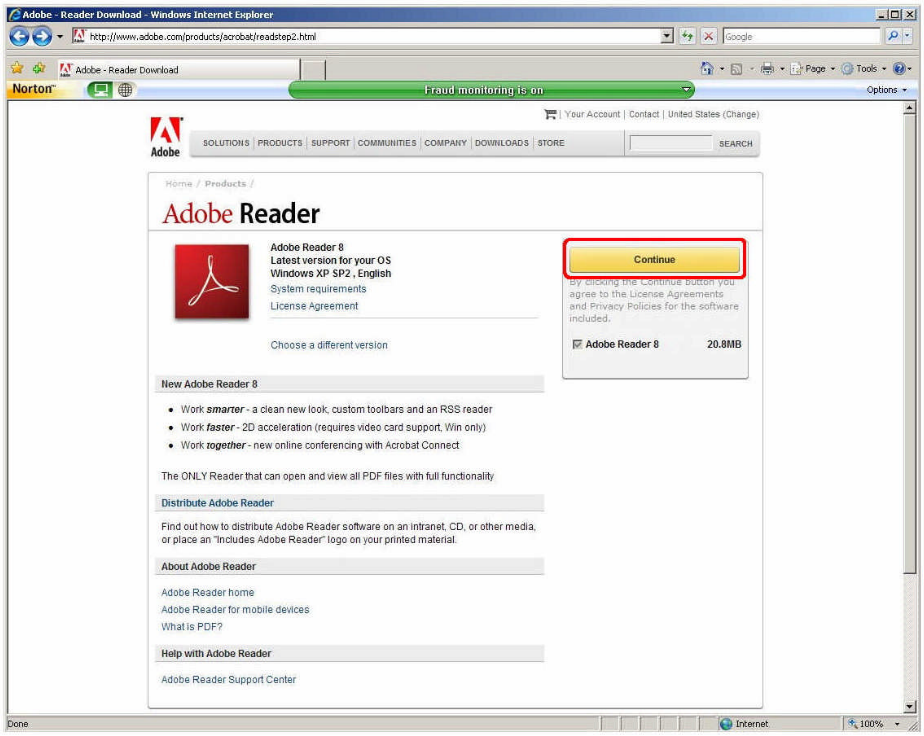


Figure 311 - The main download page.

That button is your confirmation of the License Agreement. Make sure to read the license agreement if you have any concerns or questions.

On the next page there will be a button you can click to start the download process and to include an additional toolbar from Google for your browser. You must decide if you want the Google toolbar. If you're not sure what it is or are not interested in it then uncheck the box next to where it says "Free Google Toolbar" so it will not be downloaded along with the Adobe Reader (reference figure 312).

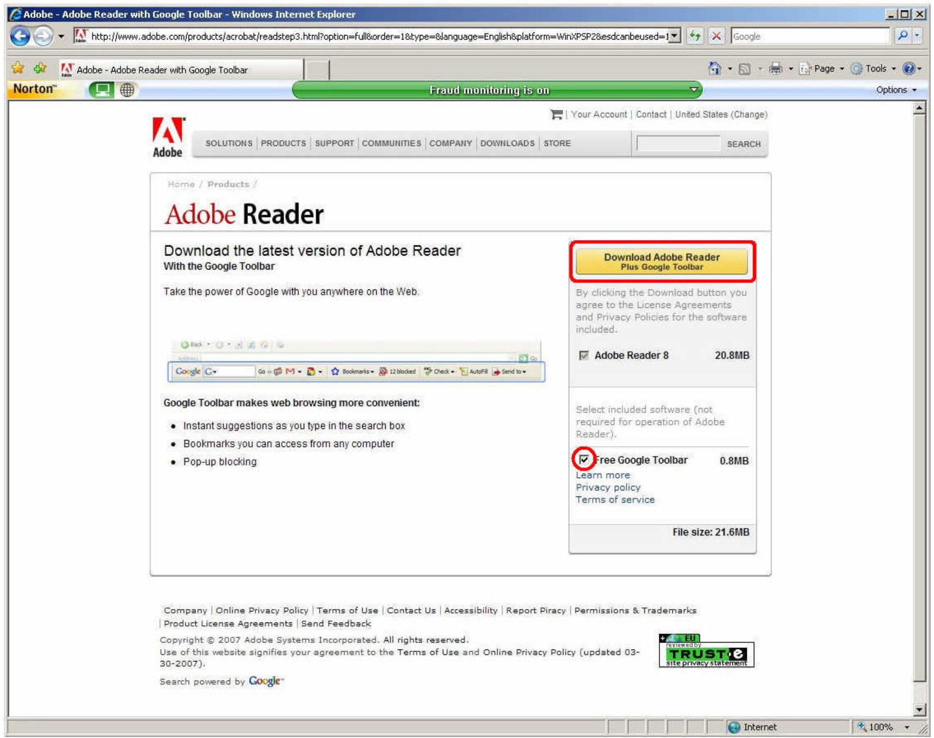


Figure 312 - The Free Google Toolbar.

The download button will change from “Download Adobe Reader plus Google Toolbar” shown in figure 312 to “Download Adobe Reader” shown in figure 313 to reflect that you are downloading only the Adobe Reader”, click on “Download Adobe Reader”.

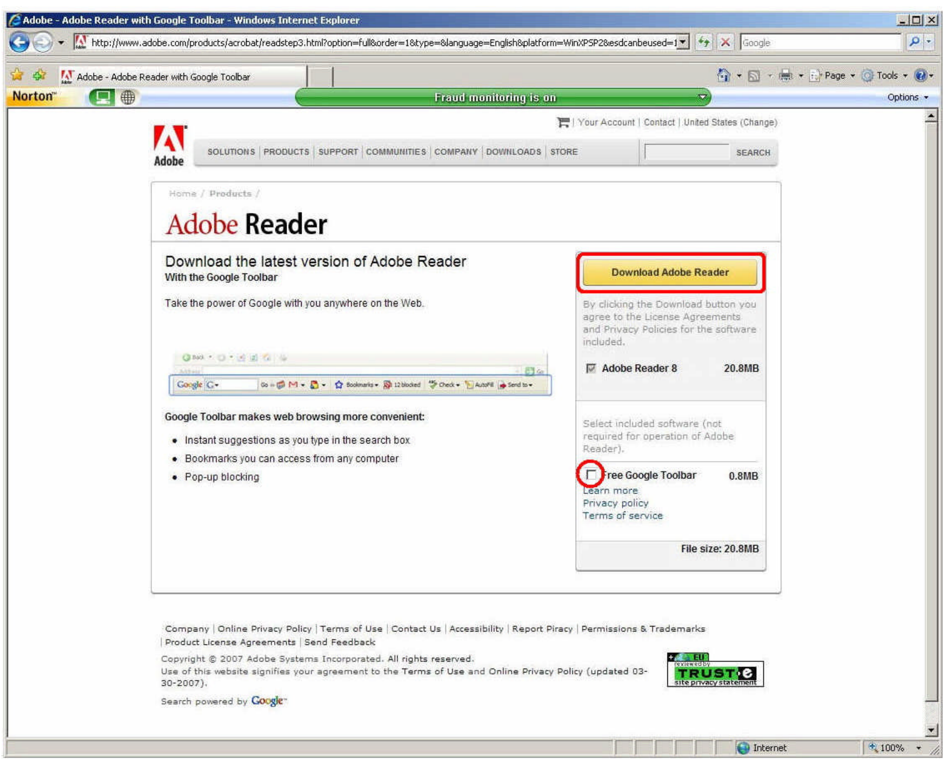


Figure 313 - Downloading just the Adobe Reader without the Google Toolbar.

Now a small window will open (reference figure 314) and present you with an option to either SAVE the Adobe Download Manager program to your hard drive (just in case you need it later or would like to share the program) or so you can install and RUN it on the spot, the choice is yours. If you do elect to save it to your hard drive you will need to remember where you put it so you can run the Download Manager program after downloading the program. For now just click on the RUN button (circled in red in figure 314).

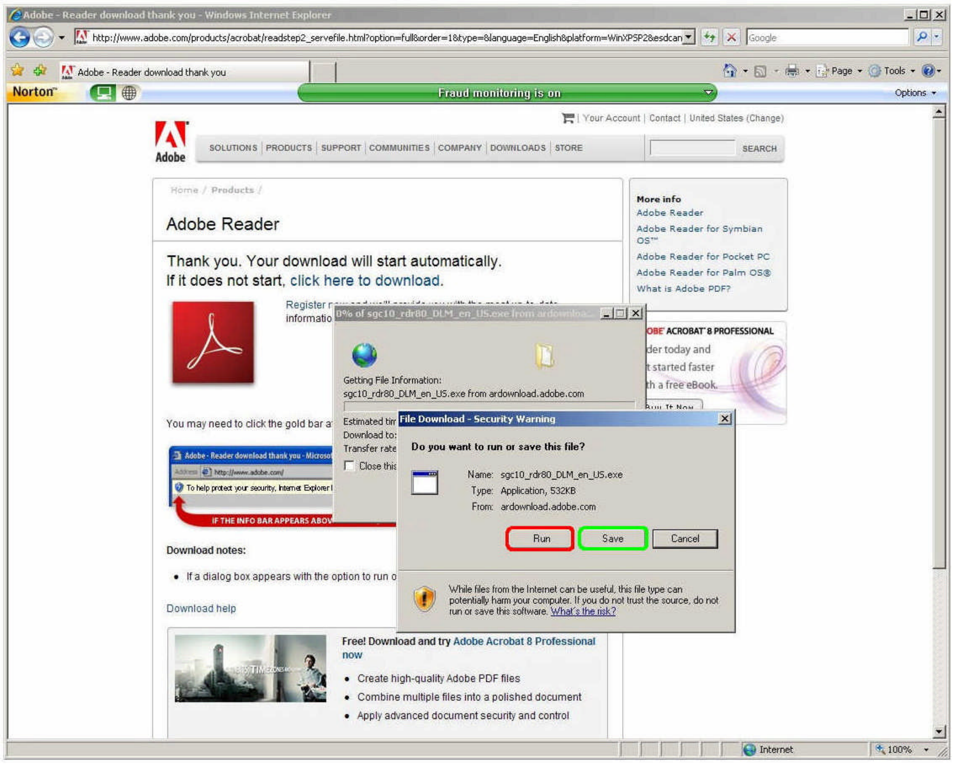


Figure 314 - Option to RUN or SAVE the Download Manager.

You are reminded that you may need to override your browser security settings if you see this info bar pop up after clicking on the RUN button. Just click on the bar to see the options and allow the download.

Figure 315 - Option to override your browser security settings.

A window will now open (reference figure 316) after downloading and installing the Download Manager is complete asking you to run the program, click on RUN.

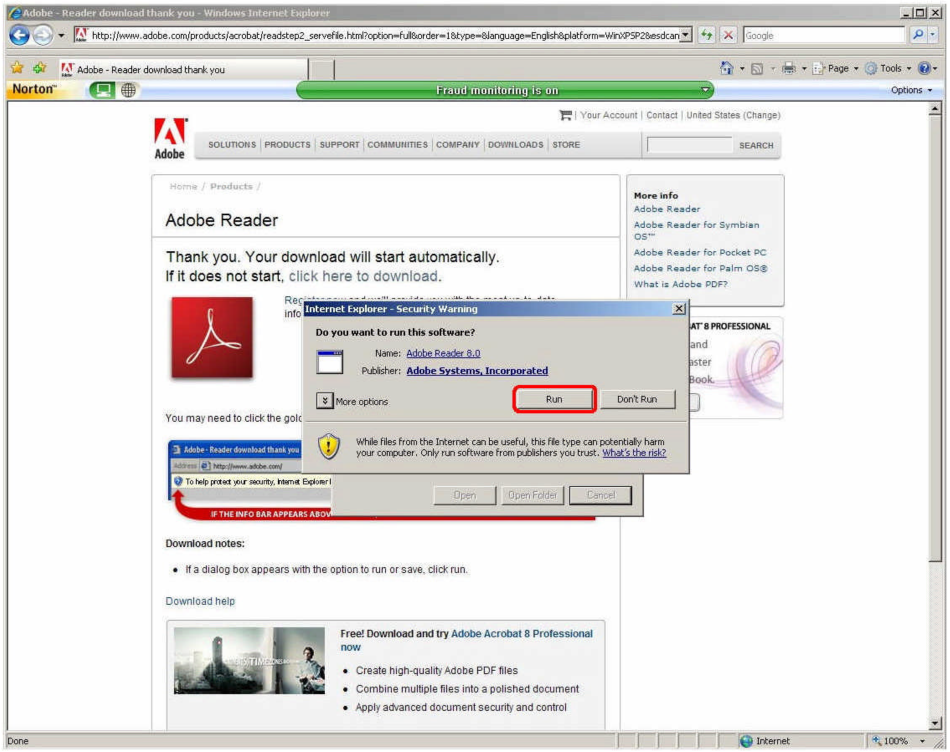


Figure 316 – Running the Download Manager.

The Adobe Download Manager will now download the Adobe Reader program itself as seen in figure 317.

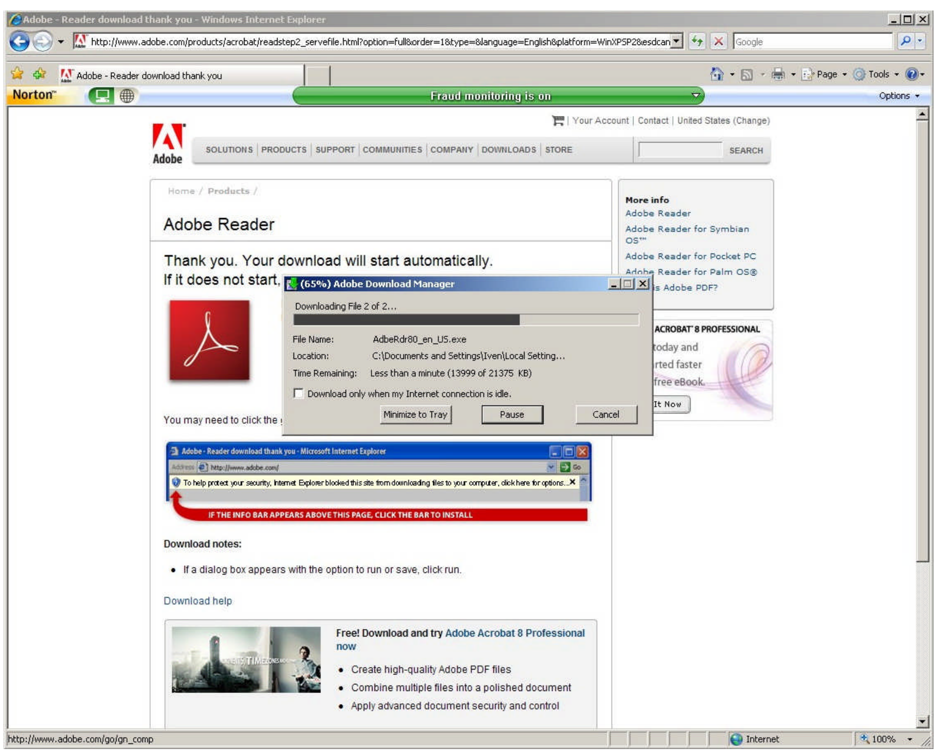


Figure 317 - Downloading the Adobe Reader.

When the download is completed another window is presented (reference figure 318) asking whether you wish to install the reader now or later (what do you think? <grin>), click on INSTALL NOW.

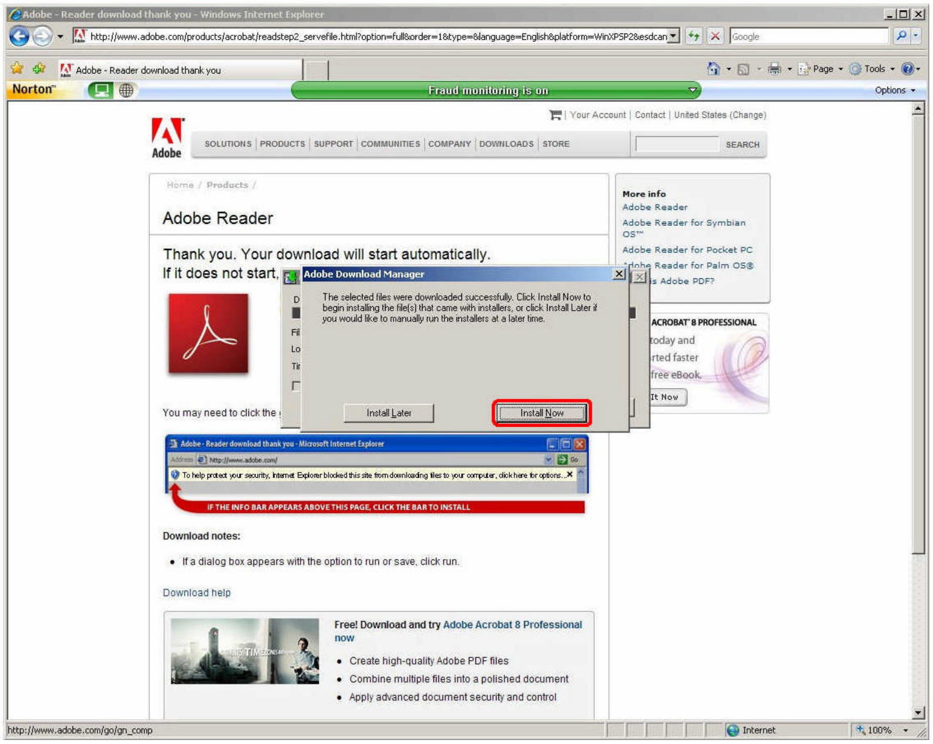


Figure 318 - Finally....installing the Adobe Reader itself.

The Adobe Reader setup program will now run and install the reader (reference figure 319).

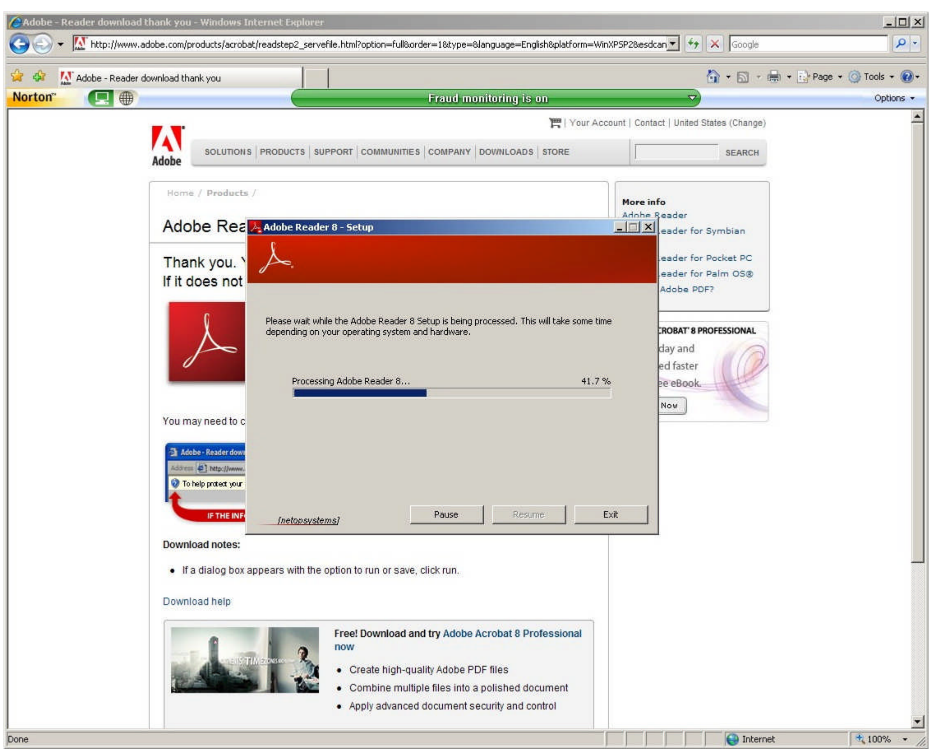


Figure 319 - The Adobe setup program.

Make sure to follow any remaining questions to complete the process, when the program is installed click on the button labeled FINISH. That's it!

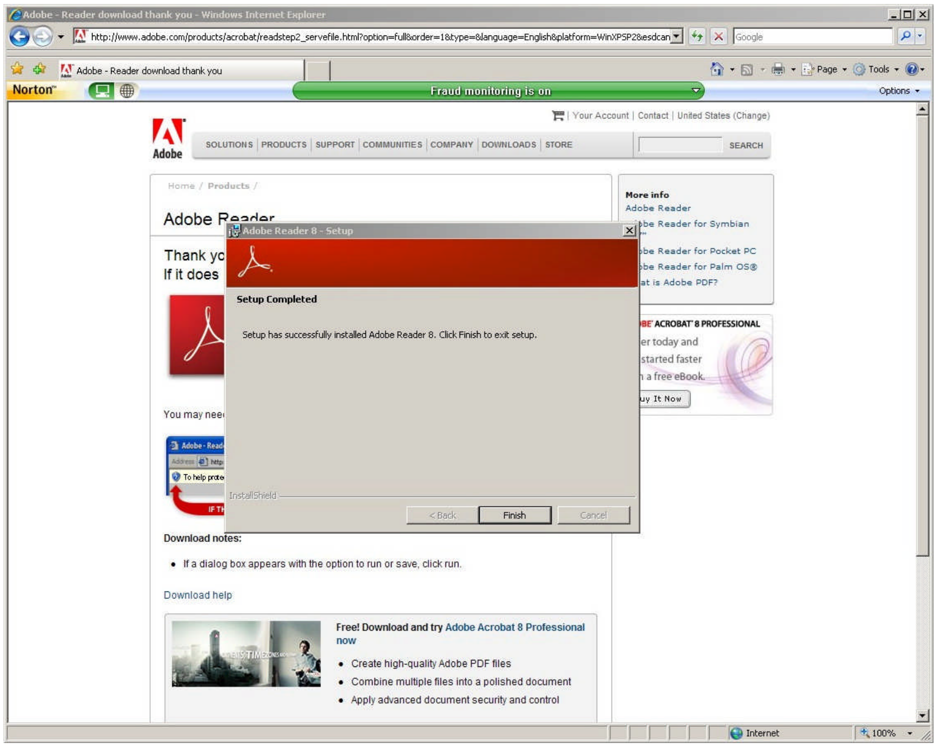


Figure 320 - The Adobe Reader is now installed and ready.

Now that you have the Adobe Reader installed you can now download and view documents saved in the PDF format.

THE NATIONAL AERONAUTICAL CHARTING OFFICE (NACO)

The National Aeronautical Charting Office compiles, reproduces, and distributes aeronautical products and digital databases for the U.S., its territories and possessions. NACO also prints and distributes all National Oceanic and Atmospheric Administration (NOAA) nautical charts and related products.

NACO provides an Internet accessible outlet for pilots to readily download digital terminal procedures in PDF format (hence the installation of the Adobe Reader). These documents are kept up-to-date on a cycling basis. This makes them very handy for the simulator pilot and controller. Click on the link below to go to their starting page to obtain these documents.

http://avn.faa.gov/index.asp?xml=naco/online/d_tpp

Also, on this page is a link to obtain for a small fee (last time I ordered the disc it was $13.50) a very nice DVD disc with all the terminal procedure publications available for the U.S.A. and included on the disc is a small new program called d-TPP Flight that can be run by the simulator pilot or controller (possibly on a second monitor) to very quickly pull up and view any of the charts included in the database. This is an extremely nice product to use and you will not want to be without it once you do use it. It does not include any frills; the program works intuitively to provide the charts and information required.

Figure 321 - The d-TPP Flight program.

Click on the link to the d-TPP DVD as seen in figure 322.

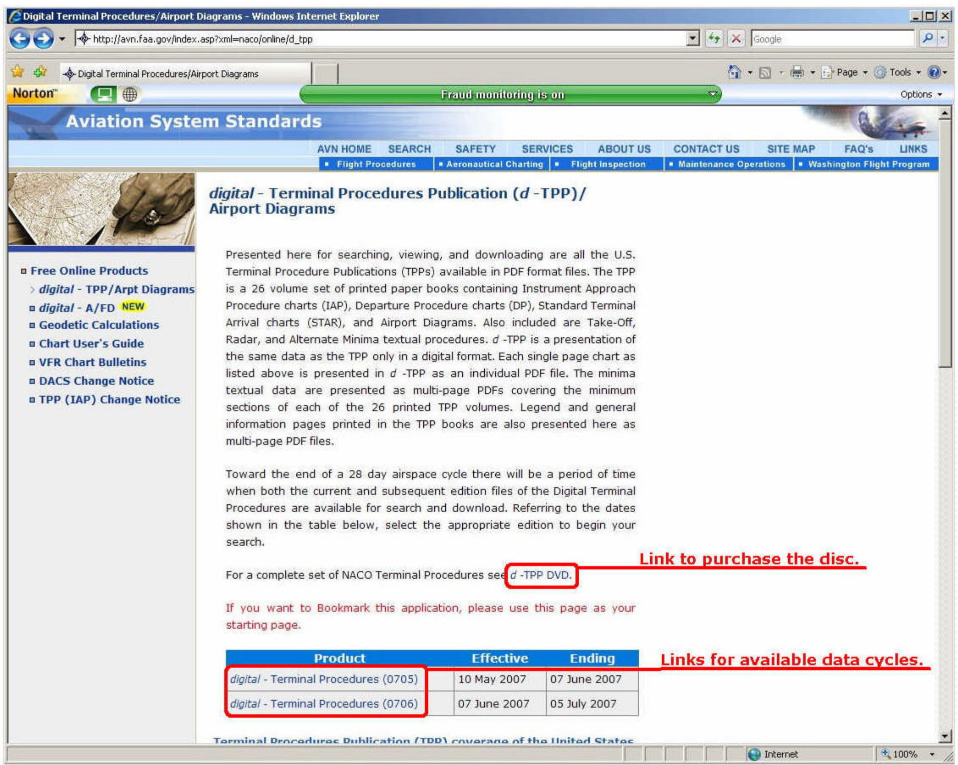


Figure 322 - Link to the d-TPP Flight program order page.

This will take you to the page in figure 323 (the page shown is scrolled to the bottom).

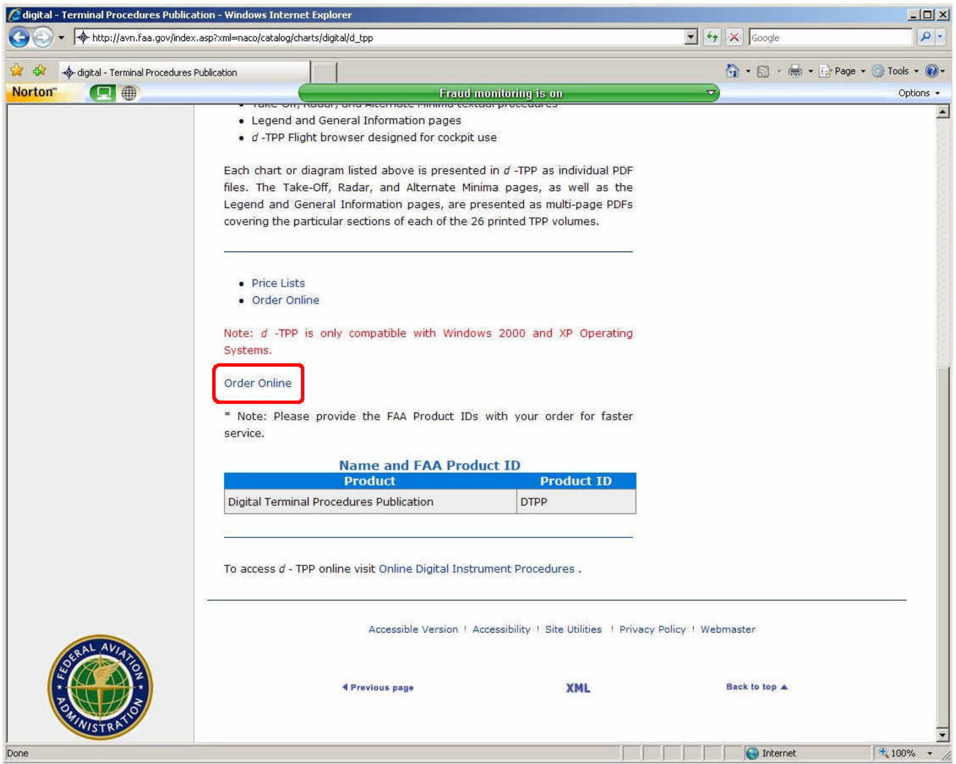


Figure 323 - The online order page for the d-TPP DVD.

Just click on the “Order Online” link to reach the page that will start the order process as seen here in figure 324.

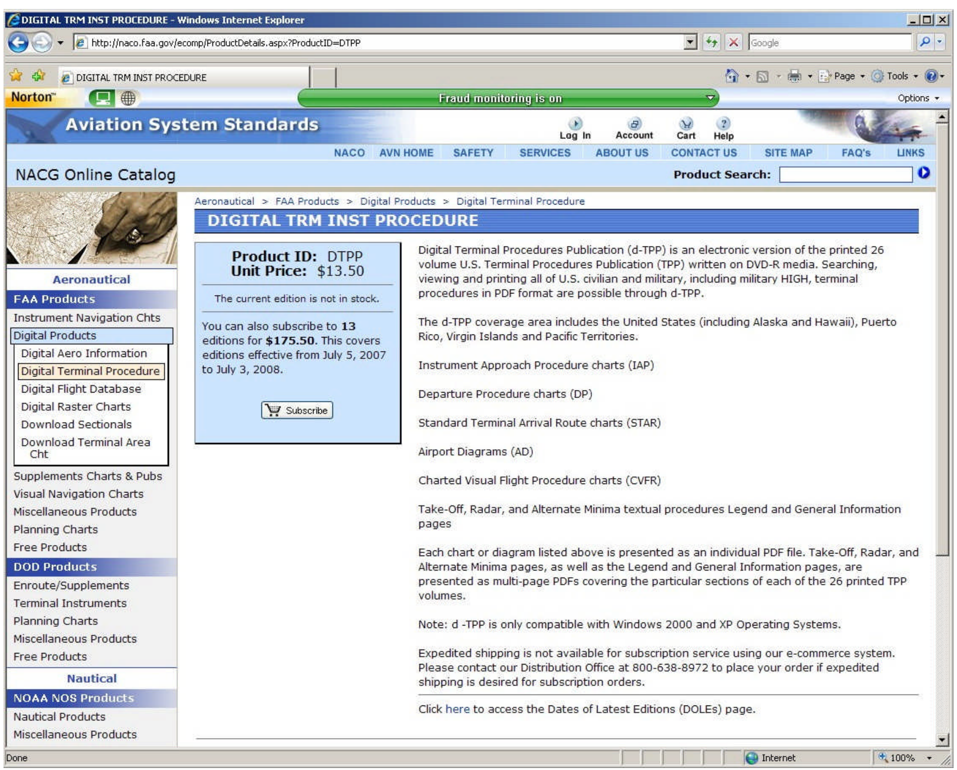


Figure 324 - Purchasing the d-TPP DVD online.

If you only see the button to subscribe to the program (for a whopping $175.00) then this typically means they do not have the current edition in stock as a single disc (read the screen closely). Wait a few days and go back to check and see if they have it. Of course the subscription is for real-world pilots who are required to use current charts all the time. Once you get your disc and the program is loaded, when started it will show you the screen in figure 325.

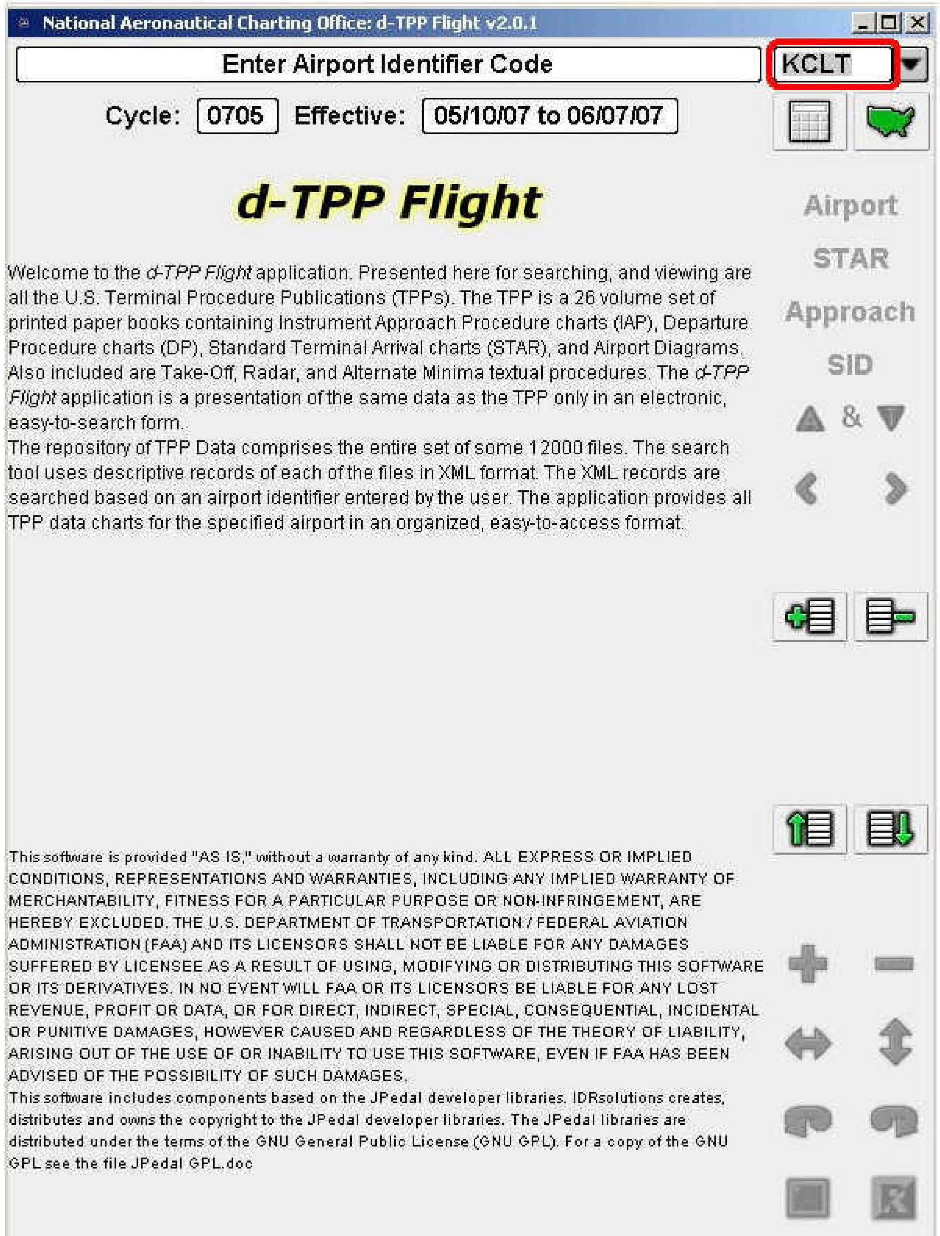


Figure 325 - Introduction to the d-TPP Flight program.

All you need to do to view ANY of the various terminal procedures or airport diagrams for an airport is to type the ICAO identifier in the upper right-hand entry block (KCLT is entered in the block seen in figure 325) and press enter on your keyboard. This will display by default the airport diagram as seen in figure 326. Note that if you don't find an airport which should be listed (some ICAOs are not listed as a standard ICAO) then click on the small green US map to select a state or territory and find the airport you want.

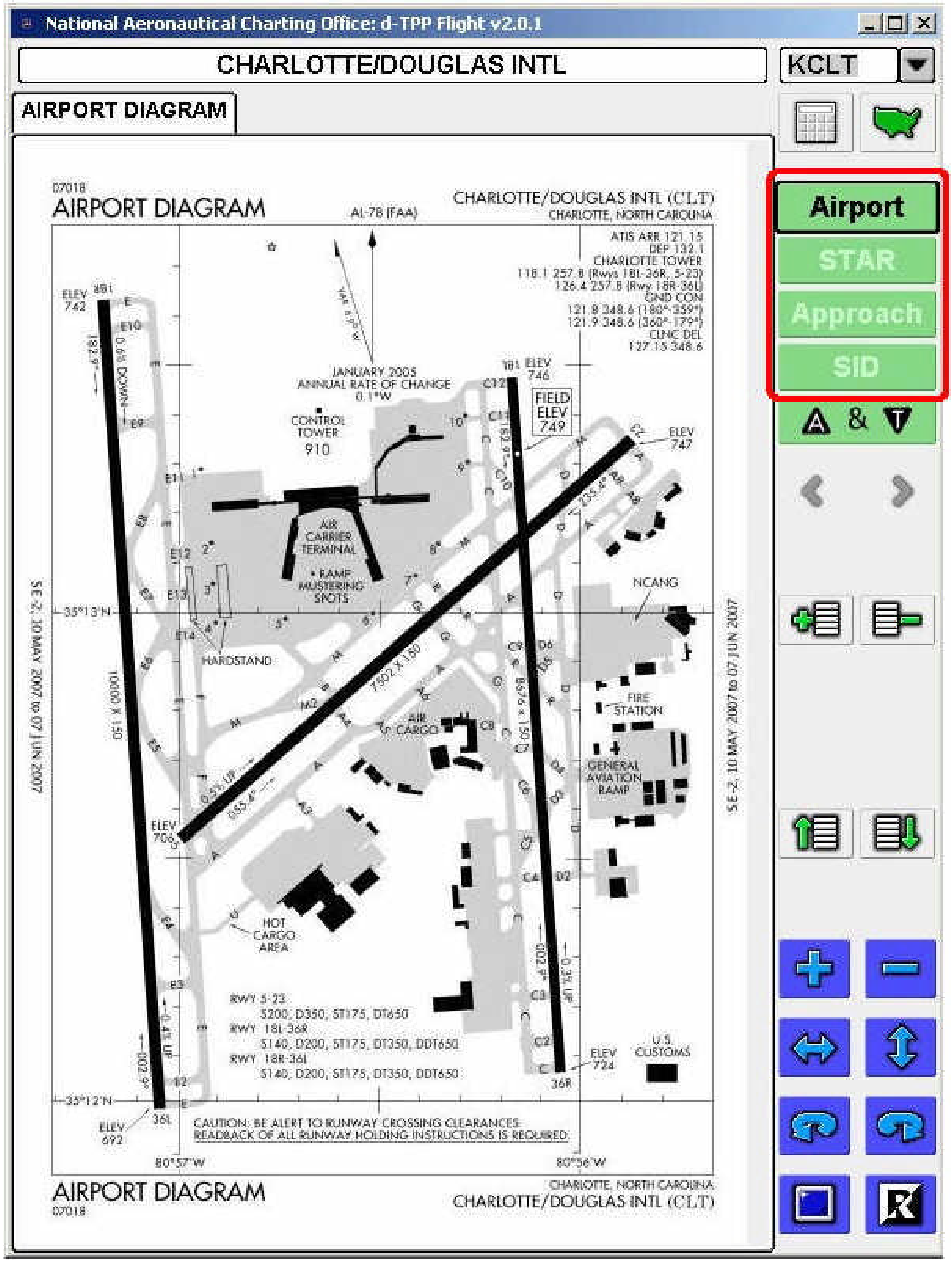


Figure 326 - The KCLT airport diagram.

If you then click on one of the chart category buttons down the right-hand side as seen in figure 326 you can quickly select a STAR, Approach, or SID available for the airport. Figure 327 shows a STAR selected after clicking on the STAR button.

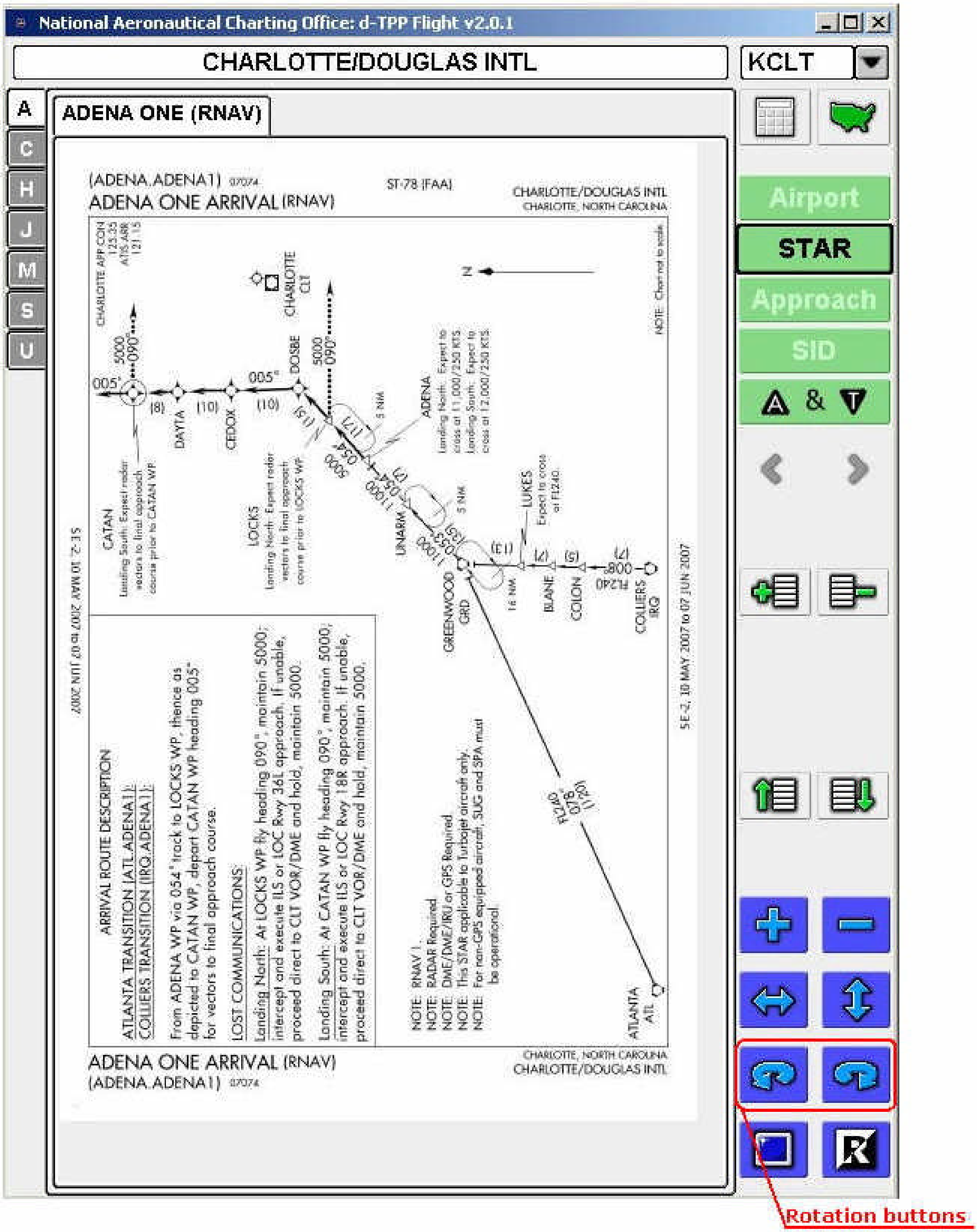


Figure 327 - The ADENA ONE (RNAV) STAR for KCLT.

Clicking on the Approach button will display the various approaches available at KCLT as seen in figure 328. The above STAR chart can be rotated by one of the buttons in the lower right side to view it in a landscape format.

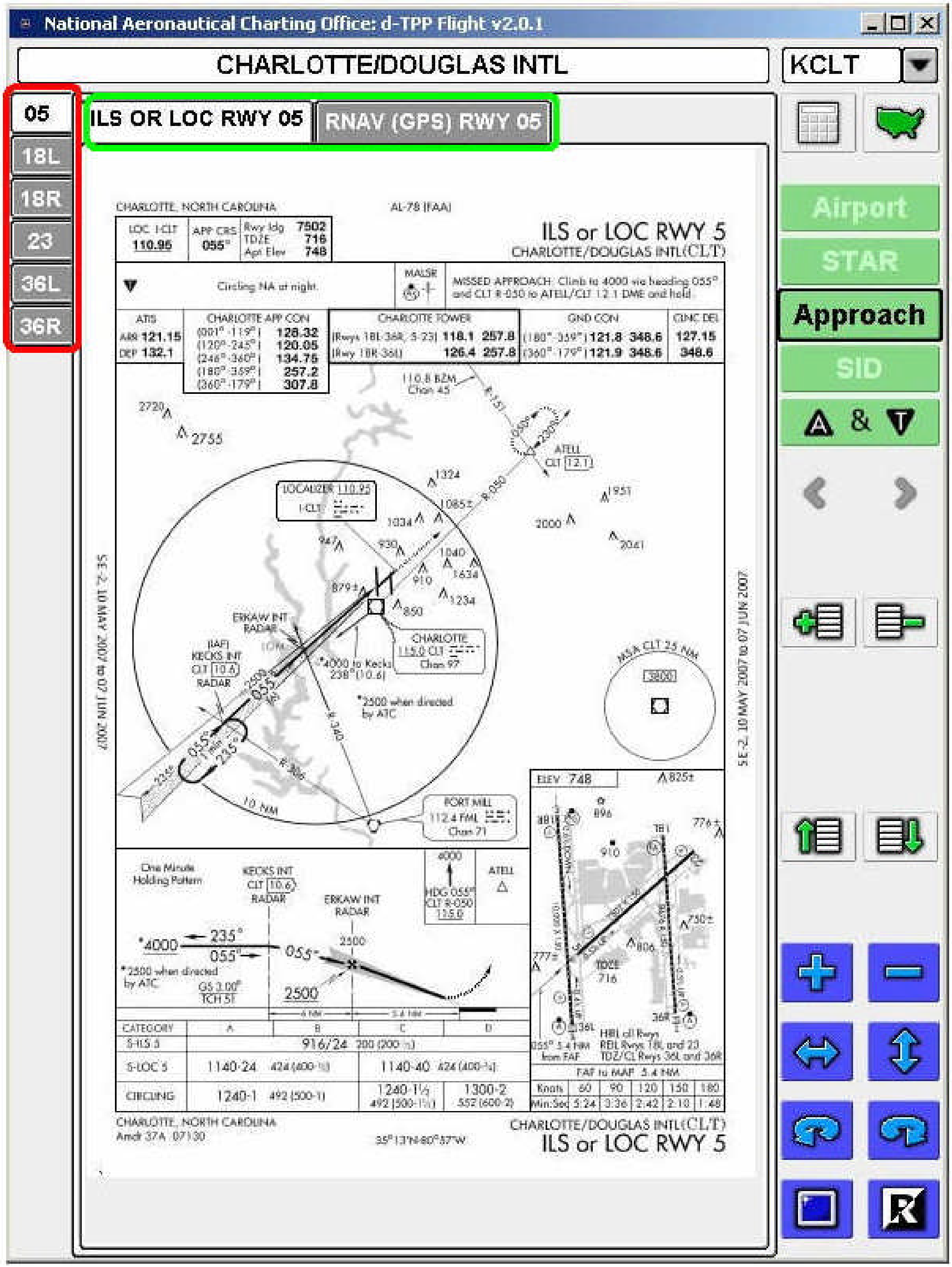


Figure 328 - Approaches for KCLT.

Notice the convenience of using the tabs (circled in red and green) in the program. As seen in figure 328 if the 05 tab (which represents runway 5 at KCLT) is selected then the upper tabs circled in green will show all the approaches available for runway 5 and easily selected. If you are running the program (displayed maybe on a second monitor) then this is just like having a kneeboard in the cockpit. Very handy indeed!

There are other little features and functions available to manage the displayed charts such as buttons to quickly zoom in and out. There are other buttons to shift the chart left and right or up and down. You can "grab" the chart with the mouse and drag it around when zoomed in close. There is also a handy feature to have several different airports available (grouped) for instant access.

Now, what if you don't get the DVD disc, well that brings us back to the NACO web site and how to download the freely available charts and diagrams. So you'll need to click on the link provided above once again to get a fresh start. That will again take you to the main page as in figure 329.

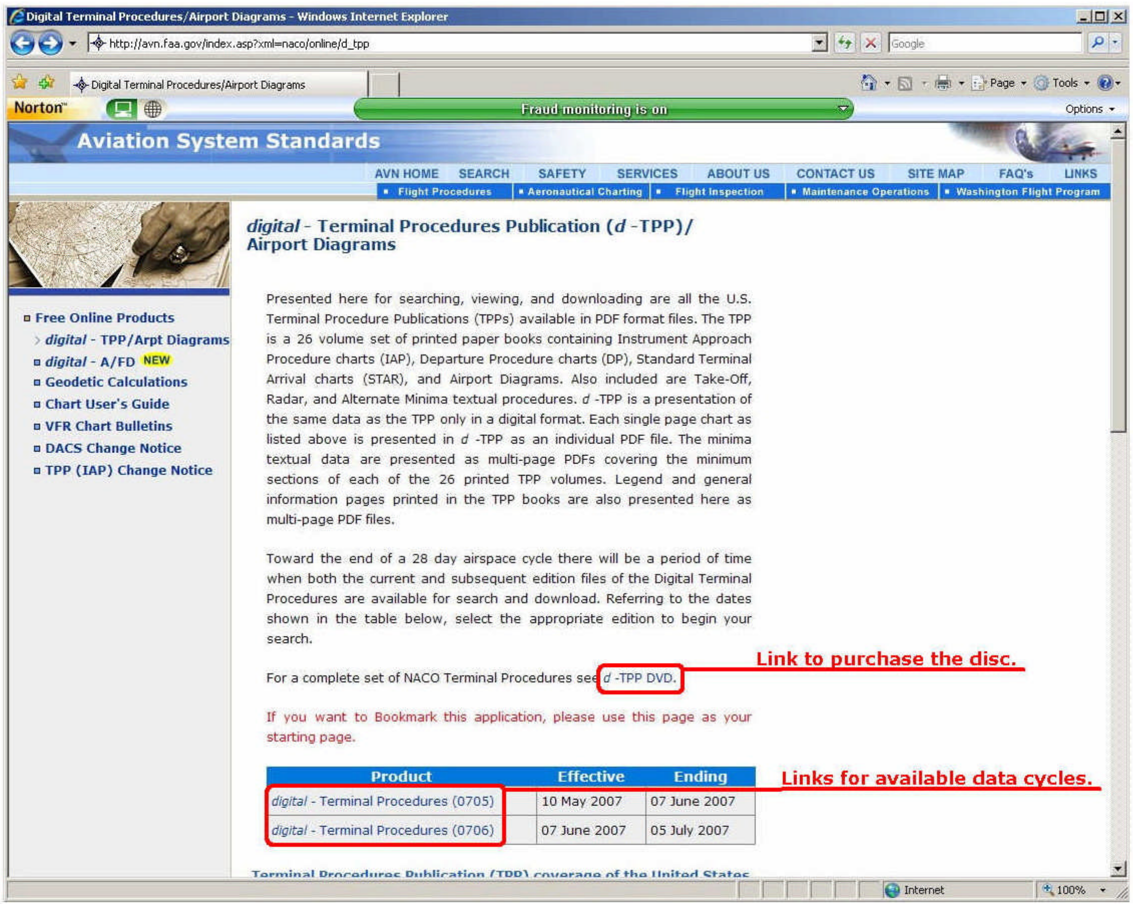


Figure 329 - The NACO Digital Terminal Procedures Publication (d-TPP)/Airport Diagrams page.

Once on the page click on the most current cycle available (pictured in figure 329 is the 0706 cycle). That will take you to the page in figure 330. There you can click on any of the U.S. States or territories to begin your search for the airport of interest.

Figure 330 - Click on one of the states or territories.

I'll click on North Carolina (I can't help myself as that is my stomping grounds <grin>) to obtain an example chart.

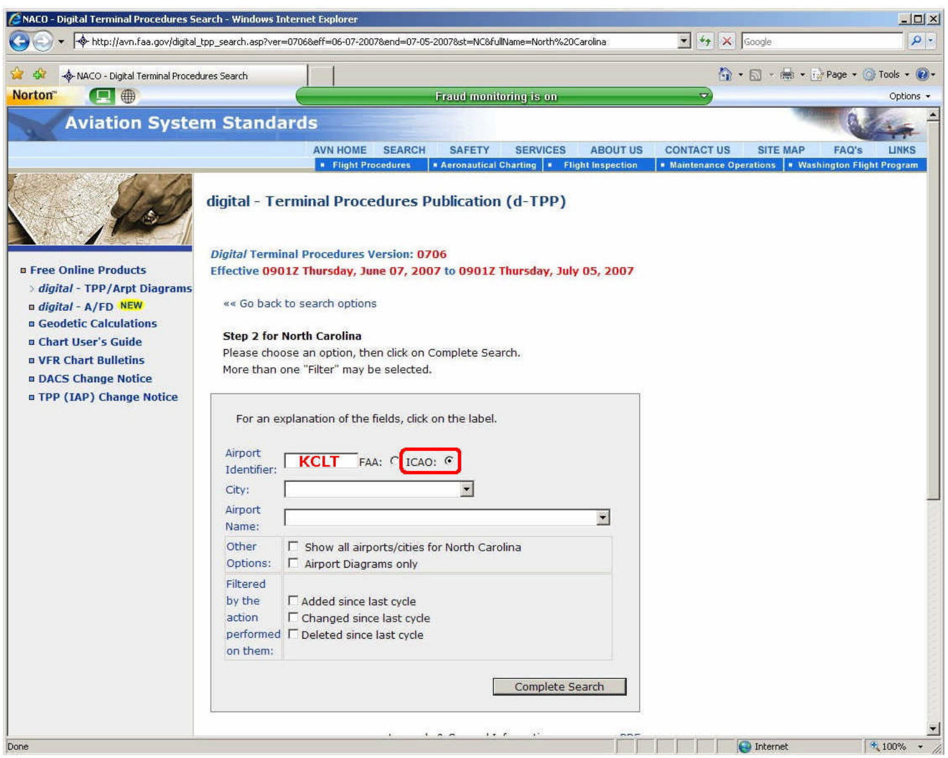


Figure 331 - Searching for an airport.

After clicking on the state of North Carolina the page appears as seen in figure 331. Since I'm going to stick with using an ICAO reference I'll need to make sure the "bullet" is on the ICAO selection. I'll then type KCLT into the airport identifier block and click "Complete Search".

At this point a listing for all terminal procedures including the airport diagram will be listed on the screen as seen in figure 332.

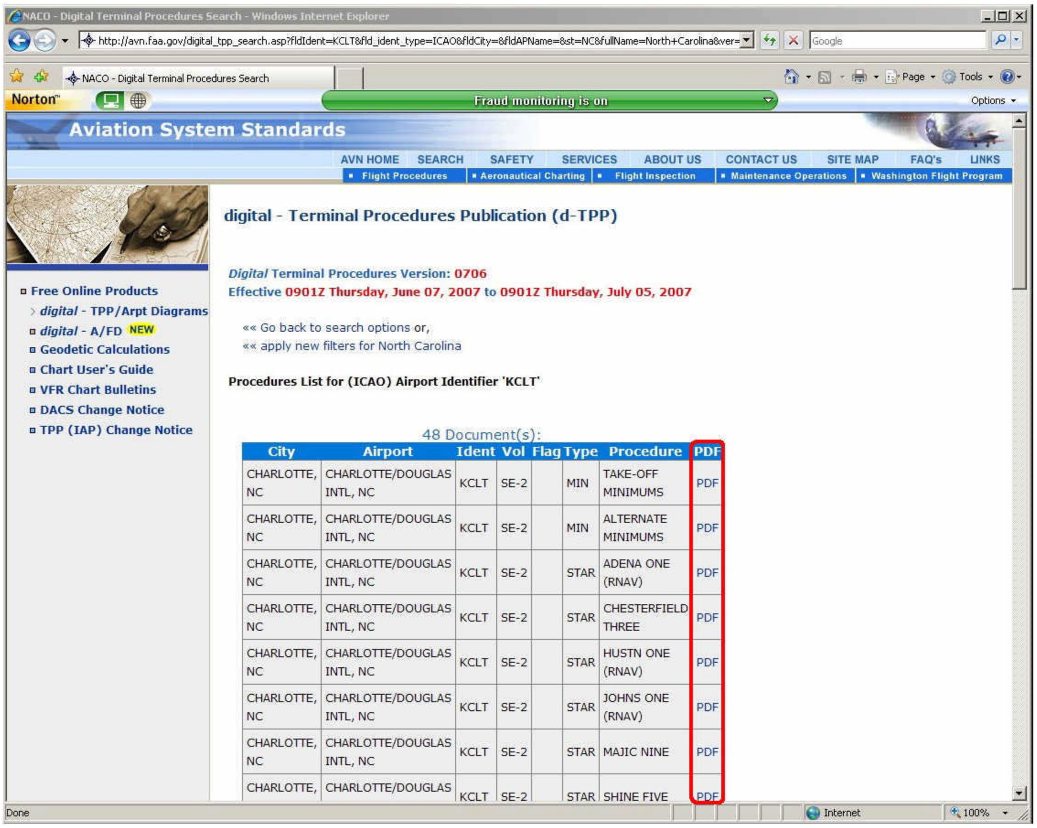


Figure 332 - Terminal procedures and airport diagram listed for KCLT.

Notice the column labeled PDF. Each PDF label is a link to download the chart listed in that row. So for instance, scroll down the page until you find the IAP for ILS or LOC RWY 05, then click on the PDF link in the PDF column. If you have properly loaded the Adobe Reader then the approach chart for the ILS/LOC RWY 05 will be displayed by the reader as seen here in figure 333.

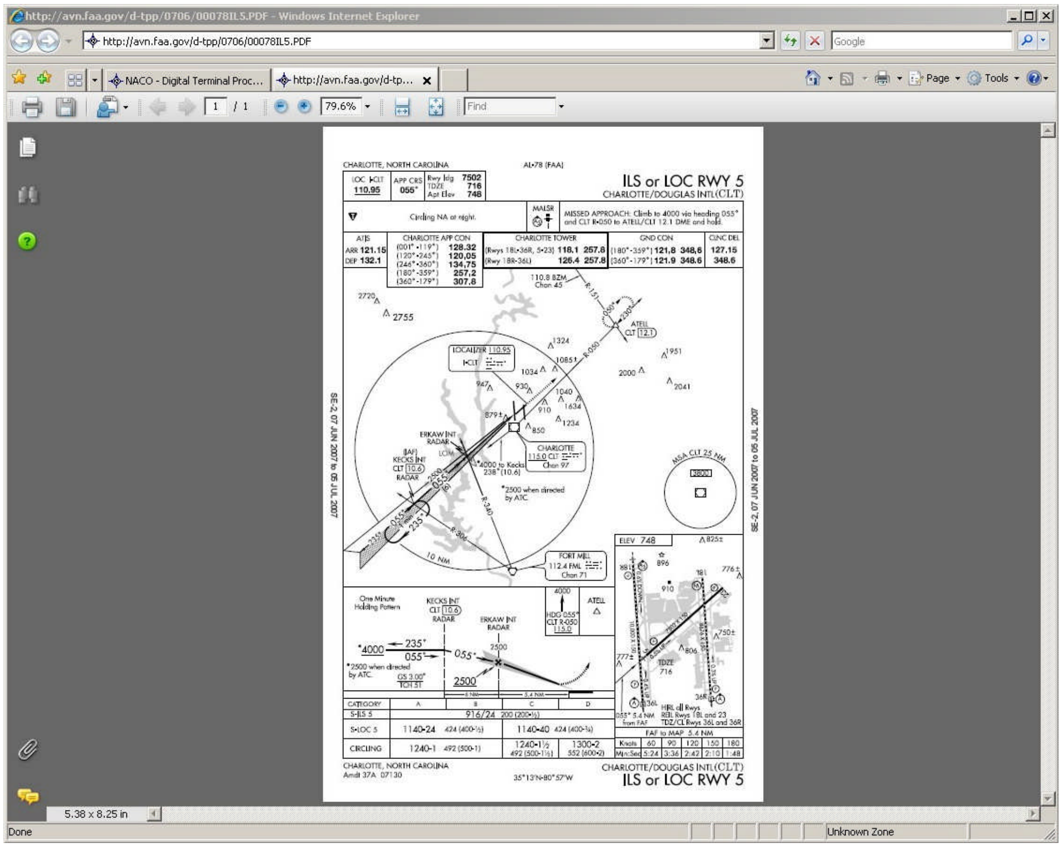


Figure 333 - The Adobe Reader displaying the KCLT ILS/LOC RWY 05 approach chart.

You can view the chart in the reader, you can make a high quality printout of the chart using the reader, or you can even save the chart to your hard drive for future use without having to download it again.

As with the d-TPP Flight program, you can have your browser open and displayed on a second monitor so you can download the charts you require during an online ATC activity (just like the d-TPP Flight program). Of course if you don’t have a second monitor then you’ll have to minimize and maximize the browser as required to see the charts.

That’s all there is to it! If you need charts for another airport all you need to do is use your browser back button to get to the map and select another state or territory as required, then enter the search information and click on “Complete Search” to find the charts you need.

Now that you are armed with this knowledge and skill we can move into discussions about the precision and non-precision approaches used during IFR landings.

PRECISION INSTRUMENT APPROACHES

Precision instrument approaches are the best of all electronic landing systems available today to aid the pilot in conducting safe landings at an airport when visibilities don’t permit the normal visual landing. *The one factor that distinguishes the precision approach from all other approaches is the availability of an electronic glide slope in addition to the localizer*. Typically a precision approach provides guidance along a descent path (the glide slope) from a fixed starting altitude to a point either just above the runway threshold or actually on the runway whereas the localizer provides guidance along the approach path itself. In this section I’ll describe in detail the ILS (Instrument Landing System) and GCA (Ground Controlled Approach) both of which are precision approaches.

INSTRUMENT LANDING SYSTEMS (ILS)

As mentioned the instrument landing system (ILS) is one of the most accurate landing systems in wide use today. On the ground the ILS system is made up by two primary antenna arrays that transmit the required localizer (path/course) and glide slope (descent path) signals. The glide slope antenna array is easily spotted because of the three directional antennas mounted on a tower near the end of the runway adjacent the landing touchdown zone.

Figure 334 - ILS glide slope antenna array near the end of the runway.

The localizer antenna array is located on the ***opposite*** end of the landing runway spread along it's width as seen in figure 335.

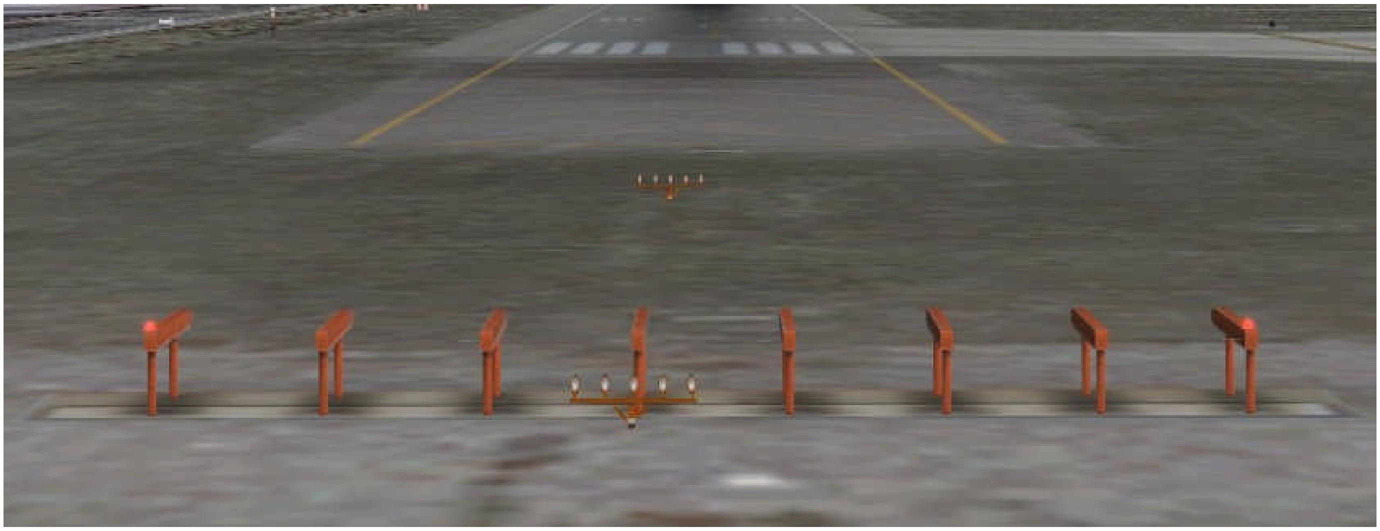


Figure 335 - Localizer antenna array at the end of the runway.

These two signals combine to form what affectively would look like a set of crosshairs in a gun scope projected at a specific angle upward away from the runway on a specific bearing. Figure 336 depicts the typical ILS system and components. Notice the location of the UHF glide slope transmitter and the VHF localizer transmitter in relationship to the landing end of a runway and also note the back course localizer beam that is emitted from the opposite runway end (I'll discuss this back course localizer beam more shortly). Typically the ILS is configured along the front course of the localizer.

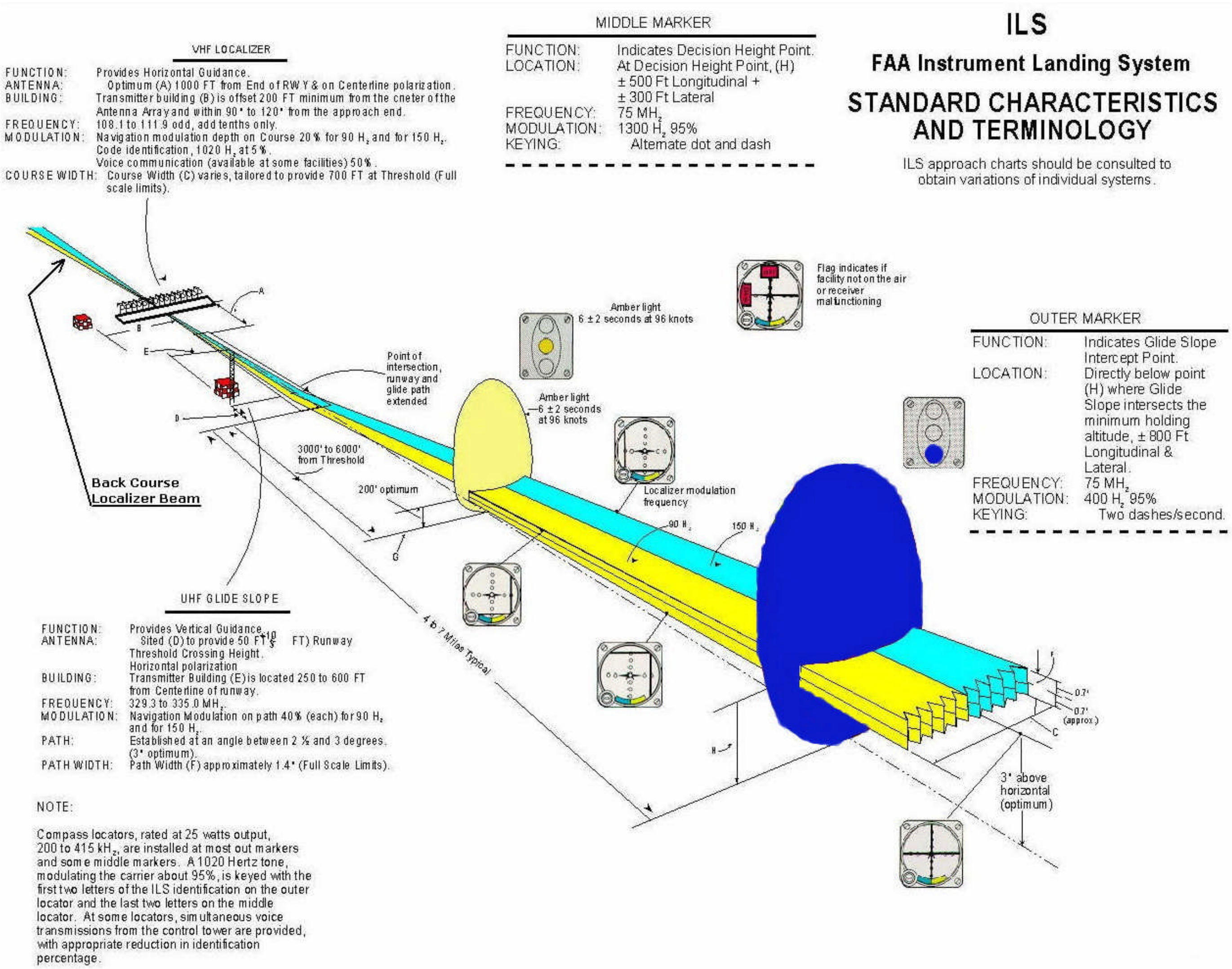


Figure 336 - ILS overview and components.

There are 40 standard VHF/UHF frequencies setup for ILS use. The pilot uses an ILS landing system by tuning one of the VHF frequencies into the navigation receiver. The receiver automatically tunes the matching UHF frequency for the glide slope (reference figure 337 which lists the 40 ILS VHF/UHF frequencies).

Localizer (MHz)	Glideslope	Localizer (MHz)	Glideslope	Localizer (MHz)	Glideslope
108.10	334.70	109.50	332.60	110.90	330.80
108.15	334.55	109.55	332.45	110.95	330.65
108.30	334.10	109.70	333.20	111.10	331.70
108.35	333.95	109.75	333.05	111.15	331.55
108.50	329.90	109.90	333.80	111.30	332.30
108.55	329.75	109.95	333.65	111.35	332.15
108.70	330.50	110.10	334.40	111.50	332.90
108.75	330.35	110.15	334.25	111.55	332.75
108.90	329.30	110.30	335.00	111.70	333.50
108.95	329.15	110.35	334.85	111.75	333.35
109.10	331.40	110.50	329.60	111.90	331.10
109.15	331.25	110.55	329.45	111.95	330.95
109.30	332.00	110.70	330.20		
109.35	331.85	110.75	330.05		

Figure 337 ILS VHF/UHF frequencies.

When an ILS frequency is tuned into the navigation receiver the appropriate gauges in the cockpit linked to the receiver are fed the signals and translate those signals into visual indications via course deviation indicators (CDIs) so the pilot can determine if the aircraft is on the proper approach path and descent. Reference the RMI gauge in figure 338 (*note that some gauges may not have the glide slope deviation indicator but just the localizer deviation indicator such as the default Cessna 172 VOR2 gauge seen in figure 339*).

Figure 338 - RMI gauge with localizer and glide slope deviation indicators.

Figure 339 - Default Cessna VOR2 gauge with no glide slope indicator (localizer only).

There are other components of an ILS system that provide distance/range information such as the marker beacons or distance measuring equipment (DME) and also visual components such as the runway approach lighting system, touchdown/centerline lights, and the runway lights. All these aid the pilot in making a precision approach.

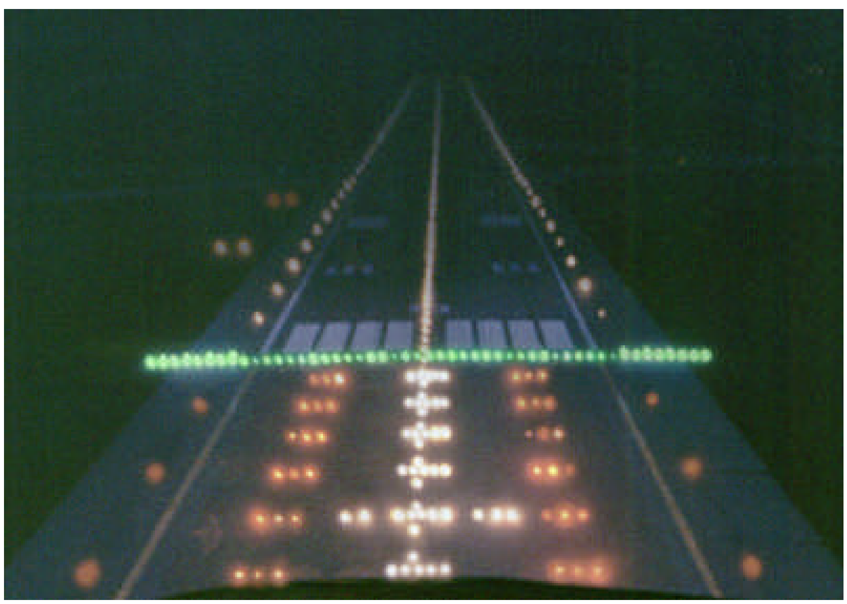
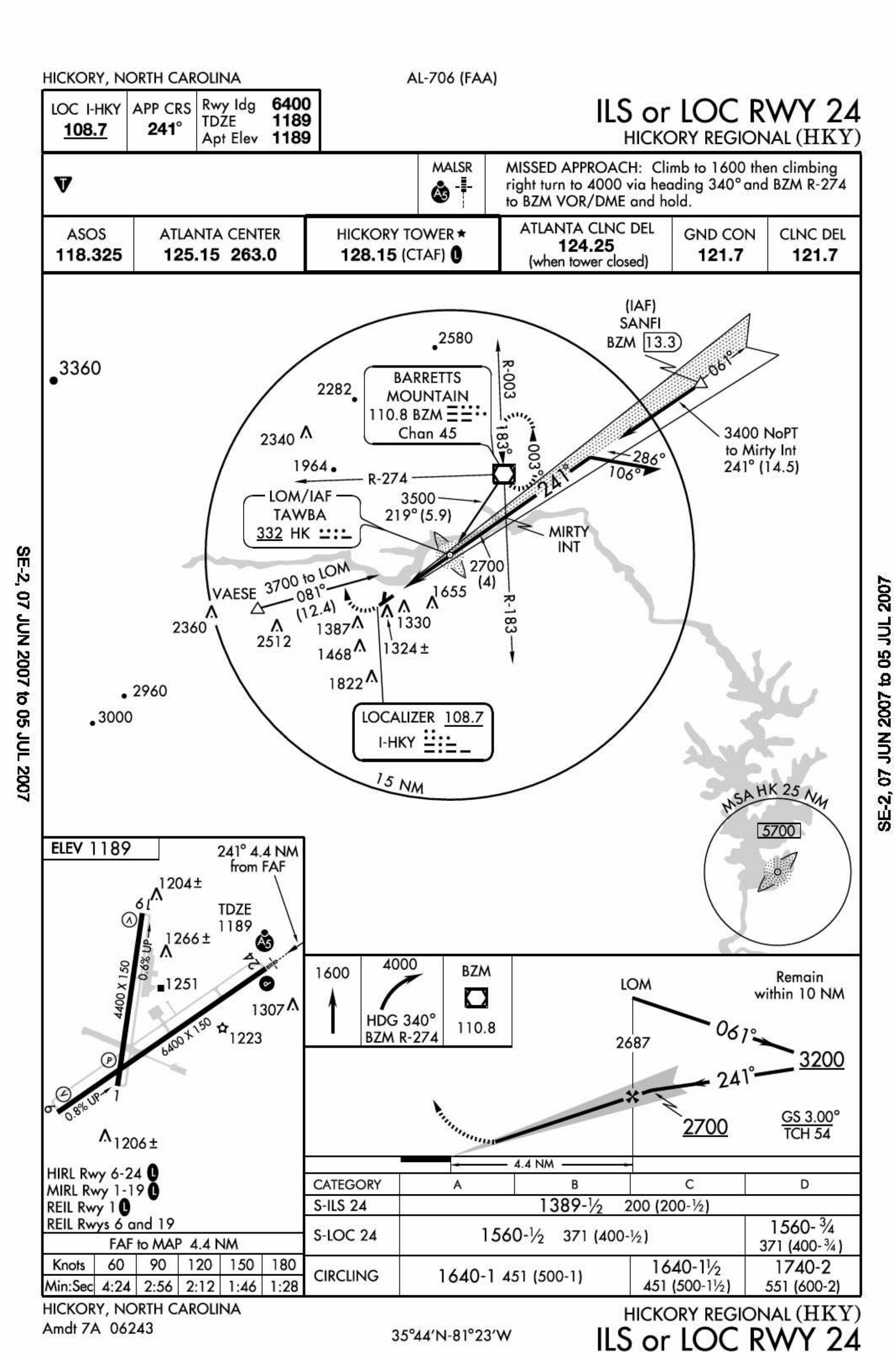


Figure 340 - A runway approach light system.

THE ILS APPROACH CHART

We discussed how to download approach charts earlier; even though I provide the chart here (reference figure 341) if you like you can download the chart as practice to read and follow along in the discussion. The approach chart you need is the ILS RWY 24 approach at Hickory Regional in North Carolina (KHKY). We'll need the chart to see relationships in information on the chart and how it is used in the cockpit to tune or adjust the gauges for an ILS landing and during discussions about the ILS procedures.

Up to this point I have given you an idea of what some of the elements are that make up a basic ILS landing system. In the discussions that follow I'll start to break down each bit of the ILS system that a pilot needs to know about (and even a controller) to properly use the system. I'll discuss properly tuning and identifying the localizer frequency, the ILS localizer course, the ILS glide slope intercept altitude, initial and final approach fixes, the ILS decision height, the ILS glide slope, and the ILS approach view.



FAF to MAP 4.4 NM					
Knots	60	90	120	150	180
Min:Sec	4:24	2:56	2:12	1:46	1:28

CATEGORY	A	B	C	D
S-ILS 24	1389-½ 200 (200-½)			
S-LOC 24	1560-½ 371 (400-½)			1560-¾ 371 (400-¾)
CIRCLING	1640-1 451 (500-1)		1640-1½ 451 (500-1½)	1740-2 551 (600-2)

HICKORY, NORTH CAROLINA
Amdt 7A 06243
35°44'N-81°23'W
HICKORY REGIONAL (HKY)
ILS or LOC RWY 24

Figure 341 - IAP chart for ILS/LOC RWY 24 KHKY.

THE ILS LOCALIZER FREQUENCY

Figures 342 and 343 are sections from figure 341 showing the primary location of the ILS localizer frequency (108.7) for runway 24 at Hickory Regional.

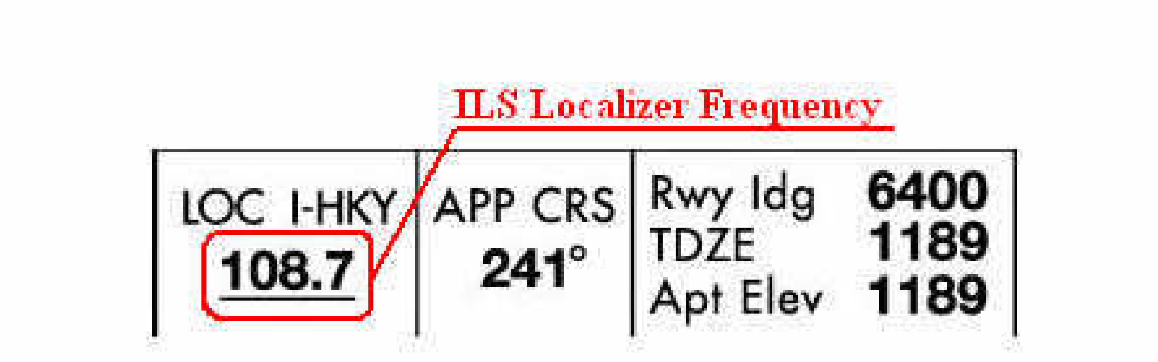


Figure 342 - ILS frequency as seen located at the top left of the approach chart.

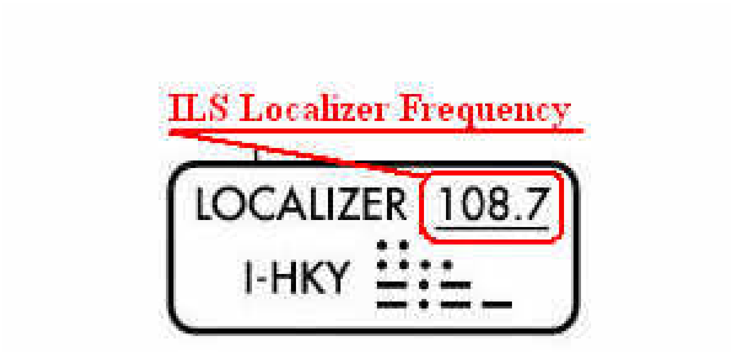


Figure 343 - ILS frequency as found in the top-down view just below the center.

The frequency 108.7 is the frequency you must dial into either your NAV1 or NAV2 radio to get the gauges to provide you with the proper information to conduct the ILS approach. Remember, even though you can tune an ILS frequency into the NAV2 receiver, the NAV2 unit can not be linked to the autopilot in flight simulator by default and the VOR2 gauge will not have the necessary glide slope deviation indicator. Unless specifically modeled into an aircraft, default aircraft can only couple the NAV1 receiver to the autopilot. In figure 344 the NAV1 receiver is tuned to the frequency 110.8 (the BZM VOR) with the ILS localizer frequency (108.7) in standby. If the pilot requires the ILS frequency be made active (instead of the BZM VOR frequency) then the pilot clicks on the standby switch to "swap" the frequencies, in other words to make it the active frequency and make the BZM VOR frequency the standby frequency. The active frequency is always shown on the left side and the standby frequency on the right side on this particular receiver.

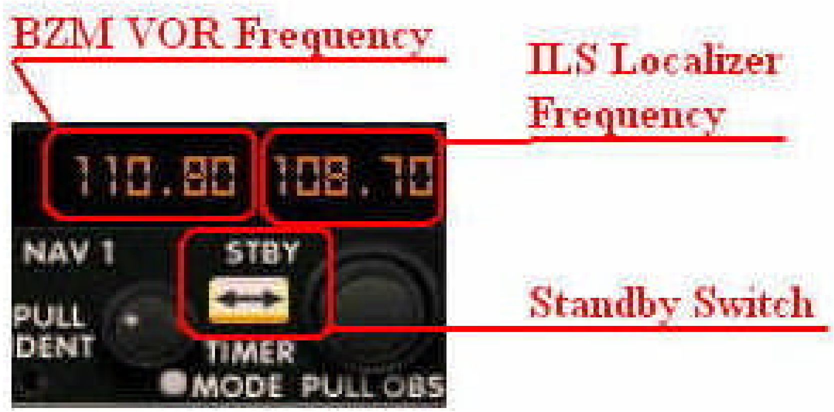


Figure 344 - Elements of the NAV1 receiver.

When ever the pilot tunes a new frequency it is common practice to check that the proper NAVAID has been tuned by listening to the Morse code identifier for that NAVAID. Figure 345 shows the Morse code identification for the localizer transmitter (I-HKY).

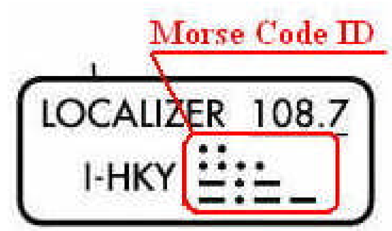


Figure 345 - Morse code identifier for the RWY 24 localizer.

A Morse code identifier can be heard if you turn on the audio button for the NAV1 or NAV2 radio. In figure 346 the COM1 and MKR audio switches are turned on, the NAV1/2 audio is turned off.

Figure 346 - The audio switch panel.

You may not think that checking this Morse code identification all too important but when you're extremely busy this simple check can keep you very safe. If for some reason you tune the receiver incorrectly but you still receive a signal then your gauge may "lie" to you causing you to track the wrong path (because you think you have it right). Depending on the situation you may or may not recognize improperly tuning the receiver right away ending in confusion or tragedy. Always practice turning on the appropriate audio and checking the Morse code identifier as provided on the chart for the transmission you are using (tuning to).

Also, if the NAV receiver is faulty or not receiving a proper signal the gauge will show red flags telling the pilot "Houston, we have a problem" as in figure 347. Don't use gauges with visible inoperative flags (called "inop" flags), typically colored red with an abbreviation for the failed component.

Figure 347 - "INOP" gauge flags.

THE ILS LOCALIZER COURSE

The second most important bit of information is the proper heading for the approach. The heading for this approach is 241° found next to the frequency at the top left.

Figure 348 - Location of the ILS localizer (approach) course.

Yes, that is 241° on your magnetic dial, not 24° as might be mistaken given the title for the chart reads "ILS RWY 24". The 241° can also be found in the top down view (reference figure 349) on the center line of the ILS "feather" depicting the inbound heading.

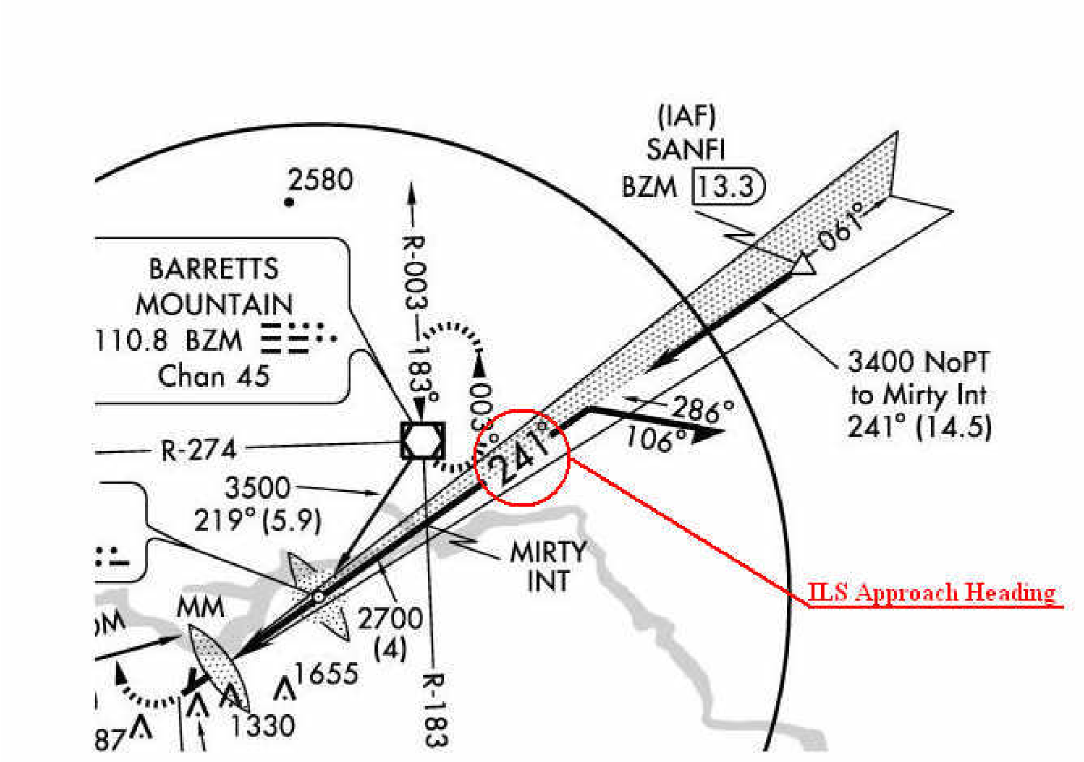


Figure 349 - Approach heading depicted on the ILS feather as seen in the top-down view.

The pilot dials this bearing into either the NAV1 or 2 gauges as shown in figure 350 using the OBS knob. On the gauge in figure 350 it is the knob on the lower left with the yellow arrow (the other knob is the heading select knob). It is very important for the pilot to understand critical differences in the gauges used for an ILS approach (or even the other approaches to be discussed shortly). For instance, if using the RMI gauge in figure 350 to conduct the ILS approach not properly setting the OBS bearing can give the pilot incorrect indications to correct deviations in course. I'll discuss this more shortly.

Figure 350 - OBS Knob.

THE ILS GLIDE SLOPE INTERCEPT ALTITUDE

The last most critical piece of information is the glide slope intercept altitude. This altitude is easily found on the approach side (profile) view that depicts the electronic glide slope. On this chart the intercept altitude is 2700 feet MSL (Mean Sea Level).

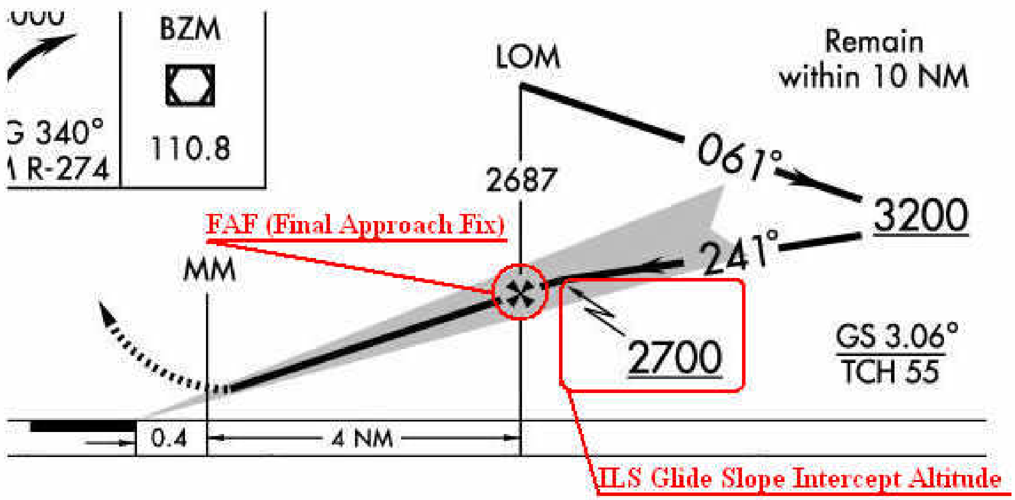


Figure 351 - The ILS glide slope intercept altitude.

Typically the pilot has the aircraft fully configured, flying level, to intercept the glide slope from underneath so as to reach the final approach fix at the assigned altitude, in this case 2700 feet MSL.

THE ILS FULL APPROACH

There is typically two ways that an approach is initiated, either by a controller providing vectors-to-final or a controller clearing a pilot to conduct a full approach. I mentioned earlier the difference between the two. Primarily during a vectors-to-final the pilot does not have to perform a full approach, which would normally include either a procedure turn or an approach entry holding pattern. Let’s discuss the full approach first.

When a full approach is conducted the pilot typically starts a procedure turn or entry holding pattern at an IAF (Initial Approach Fix) as depicted in figure 352. There can be more than one IAF depicted on an approach chart depending on the type of approach entry to be conducted so the pilot must choose the appropriate IAF for the procedure to be conducted carefully. For instance, an approach chart may show a full ILS approach by conducting a procedure turn or by conducting a DME Arc. The procedure turn will have a specific IAF and the DME Arc may have other IAFs to start the procedure to complete the ILS landing.

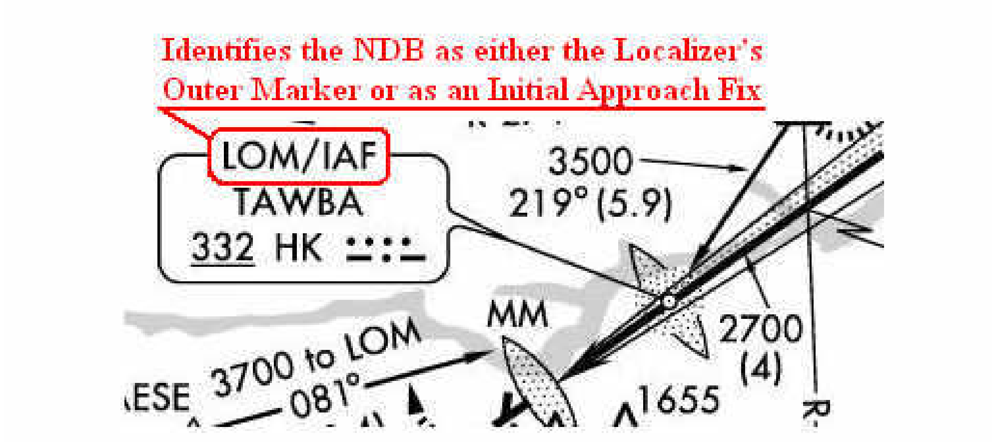


Figure 352 - Initial approach fix (IAF) at the LOM.

In our example approach chart for RWY 24 one such IAF is located at the localizer outer marker (LOM) and is used to start a procedure turn. Procedure turns are used to properly orient the aircraft on the inbound approach heading (in this case 241°) in lieu of receiving vectors-to-final by a controller.

The pilot typically starts a full approach (in this case a procedure turn) by crossing the IAF (the starting point) and then turning outbound away from the runway. The full procedure makes the pilot complete a specific maneuver to ensure the pilot gets properly oriented and gets the aircraft properly aligned on the runway heading inbound, so in this case the procedure will first guide the pilot away from the landing runway to complete the procedure turn to allow the pilot to properly intercept the localizer inbound. Take a look at figure 353.

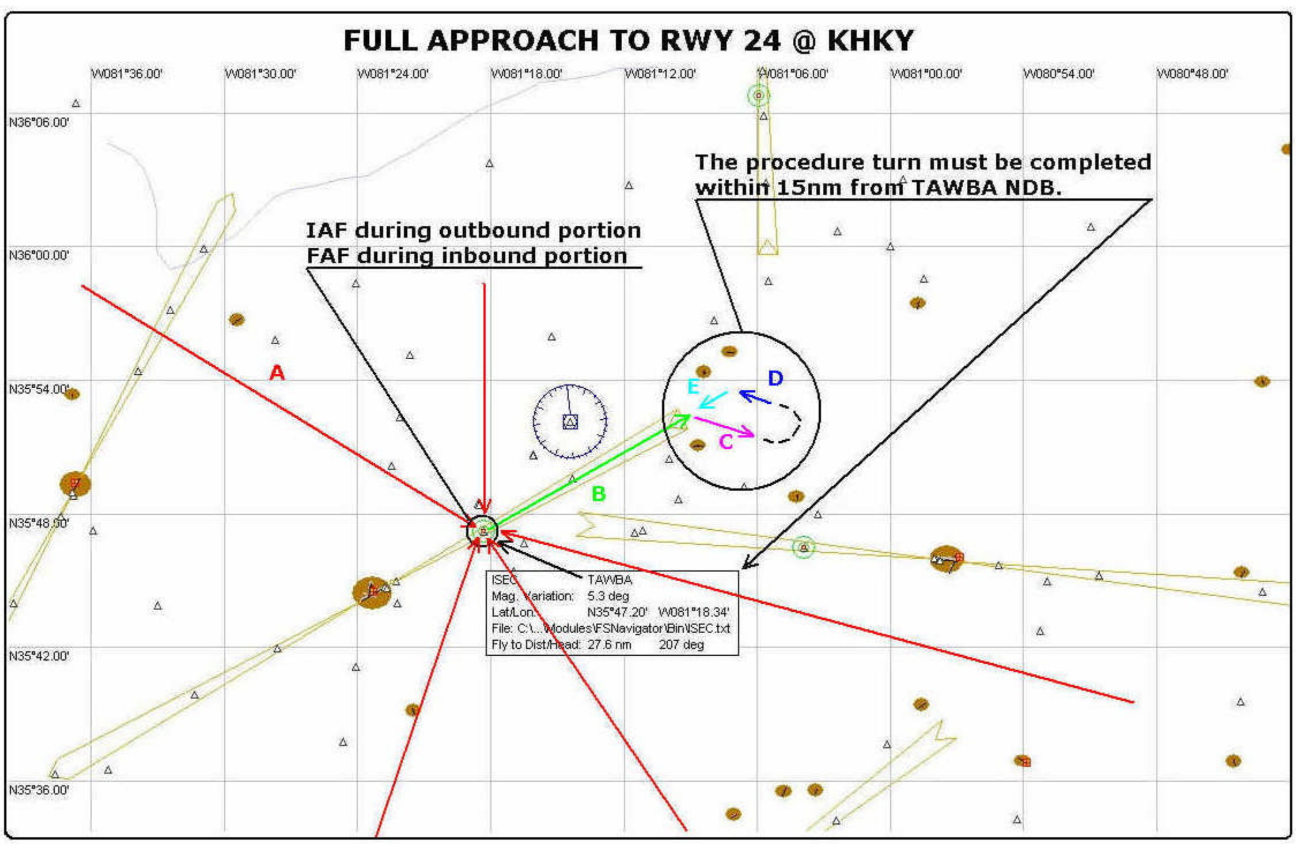


Figure 353 - The full approach to runway 24 at KHKY.

When the pilot approaches TAWBA on any of the red lines (A) (*basically from any direction)* upon reaching TAWBA the aircraft is turned outbound on the 061° heading along the green line (B), a rule-of-thumb is to travel outbound for approximately 2 to 3 minutes depending on the aircraft speed. Then while outbound *before* the pilot reaches the 15nm limit that circles the TAWBA NDB (again reference figure 341) the pilot initiates the procedure turn. The outbound portion of the procedure turn is on a heading of 106° depicted by the pink line (C) (reference the procedure turn headings in figure 353). The pilot proceeds outbound for approximately 1 to 2 minutes, again depending on the aircraft speed (1 minute for fast speeds/2 minutes for slow speeds) then turns left (always turn away from the FAF in this case TAWBA NDB) 180° until on the inbound procedure turn heading of 286° depicted by the blue line (D). The pilot should now have the OBS setting for the VOR1 gauge set to the localizer inbound heading of 241° and watching the deviation needle to see when the aircraft approaches the localizer centerline depicted by the cyan line (E). When the needle starts to move ***immediately*** start turning the aircraft toward the inbound heading 241°. If you don't start turning when the needle starts moving you will must likely fly through the localizer (*this step happens quickly!*). You need to get established on the localizer as quickly as possible before again reaching TAWBA NDB which is now referenced as the FAF (instead of the IAF). It is typical for an IAF point to be used as an FAF point during a procedure and as in this case other things can be co-located at the FAF such as the outer marker beacon (sometimes referred to as a "fan" marker) or even an NDB. When established on the localizer inbound you can descend to and maintain 2700 feet MSL until you start your descent down the glide slope as per the published approach procedure.

During the above explanation I did not include all the steps for tuning radios and adjusting heading and OBS settings if conducting the approach via the provided NAVAIDs. It should be obvious that there are several ways to track your position through the procedure turn by using proper navigation techniques taught in chapter 3 during the discussions about NDB and VOR tracking. Of course if you use the GPS 500 while coupled to the autopilot this maneuver can be completed entirely by the GPS 500 just select the proper approach using the PROC button to load the *full approach* (don't use vectors-to-final), you only need to ensure tuning the ILS localizer properly so once you are established inbound on the localizer you can switch from the using the GPS to the NAV receiver and follow the gauge used for the ILS at the proper time.

If vectors-to-final were being provided then the LOM/IAF is not used as the IAF but only as the FAF because the pilot does not need to conduct the full procedure to get established on the final approach heading (the controller is doing that for you!).

If the pilot has been cleared for a full approach then there is an altitude other than the glide slope intercept altitude (the glide slope intercept altitude is indicated by the lightning bolt connecting the 2700 to the "X") that takes on some importance. In figure 351 you will also notice a 3200 feet MSL altitude depicted on the outbound and inbound approach headings. This is the altitude the pilot must maintain throughout the procedure turn *until established on the final inbound heading of 241°*. This includes the outbound leg from the IAF going into the procedure turn, the procedure itself, and until getting established on the final inbound heading. If you reference figure 353 the pilot can descend and maintain 3200 feet MSL once crossing the TAWBA NDB outbound on the green line (B). The pilot maintains 3200 feet MSL until established inbound on the cyan line (E). Once the pilot is established on the final inbound heading (241°) the aircraft should be descended quickly to the intercept altitude of 2700 feet MSL *BEFORE* reaching the FAF (again as depicted in figure 351).

Your objective is to be flying straight and level at 2700 feet MSL fully configured for landing *BEFORE* reaching the FAF. The FAF is where the glide slope will be intercepted and the aircraft will start the descent to the runway. The most important note to stress here is the pilot should *NEVER* descend below either 3200 feet MSL or 2700 feet MSL until reaching the appropriate points while conducting a full approach.

ILS VECTORS-TO-FINAL

Most likely if you are participating in an online ATC activity you will receive vectors-to-final (this is more common than not). As mentioned vectors-to-final will allow the pilot to forgo completing the full approach which includes the procedure turn. The online controller typically in such cases clears the pilot to conduct the approach *before reaching the IAF*. The pilot then conducts the approach on their own using the published procedure for the approach. During a vectors-to-final approach the controller is doing the work to ensure the pilot is on the proper course and altitude but realize the pilot is ultimately responsible for conducting the procedure properly and should *question* anything that deviates from the procedure. The ability for a controller to use radar to conduct the intercept saves time, fuel, and can actually improve traffic sequencing and increase traffic flow, especially at larger, busier airports. The flight can proceed very smoothly from point A to point B without undue maneuvers. Also realize during online activities the pilot does ***not*** take over completing the approach themselves until the controller *clears the pilot to conduct the approach* otherwise the pilot follows the instructions issued by the controller.

Controllers use their radar (FS Navigator in our case) to provide pilot's vectors to reach an initial approach point and allow them to approach the extended runway centerline at an acceptable angle so as to eliminate excessive maneuvering and hence any confusion as to the proper navigation required to conduct the approach. The controller typically assigns safe altitudes for the pilot to maintain to avoid terrain/obstacles during the approach. These altitudes would not be unlike those the pilot will see on the approach chart (hence the reason it is good for the online controller to use the same charts the pilot would to conduct an approach themselves).

An online controller could use the approach chart for the ILS RWY 24 approach into KHKY as a template to guide incoming aircraft. Using figure 354 I'll show you how this is done. No matter what the approach is or where, the sequence of events will occur similar to this: The controller will pick a point to initially guide the pilot to, that will allow them to turn the aircraft so as to intercept the extended centerline of the final approach course (such as in this case at SANFI intersection) at an angle not greater than 30° either side of the extended centerline. This point can be an IAF or not, in this case SANFI is an IAF for the ILS approach to runway 24 at KHKY per the published approach procedure. Let's take a look at that.

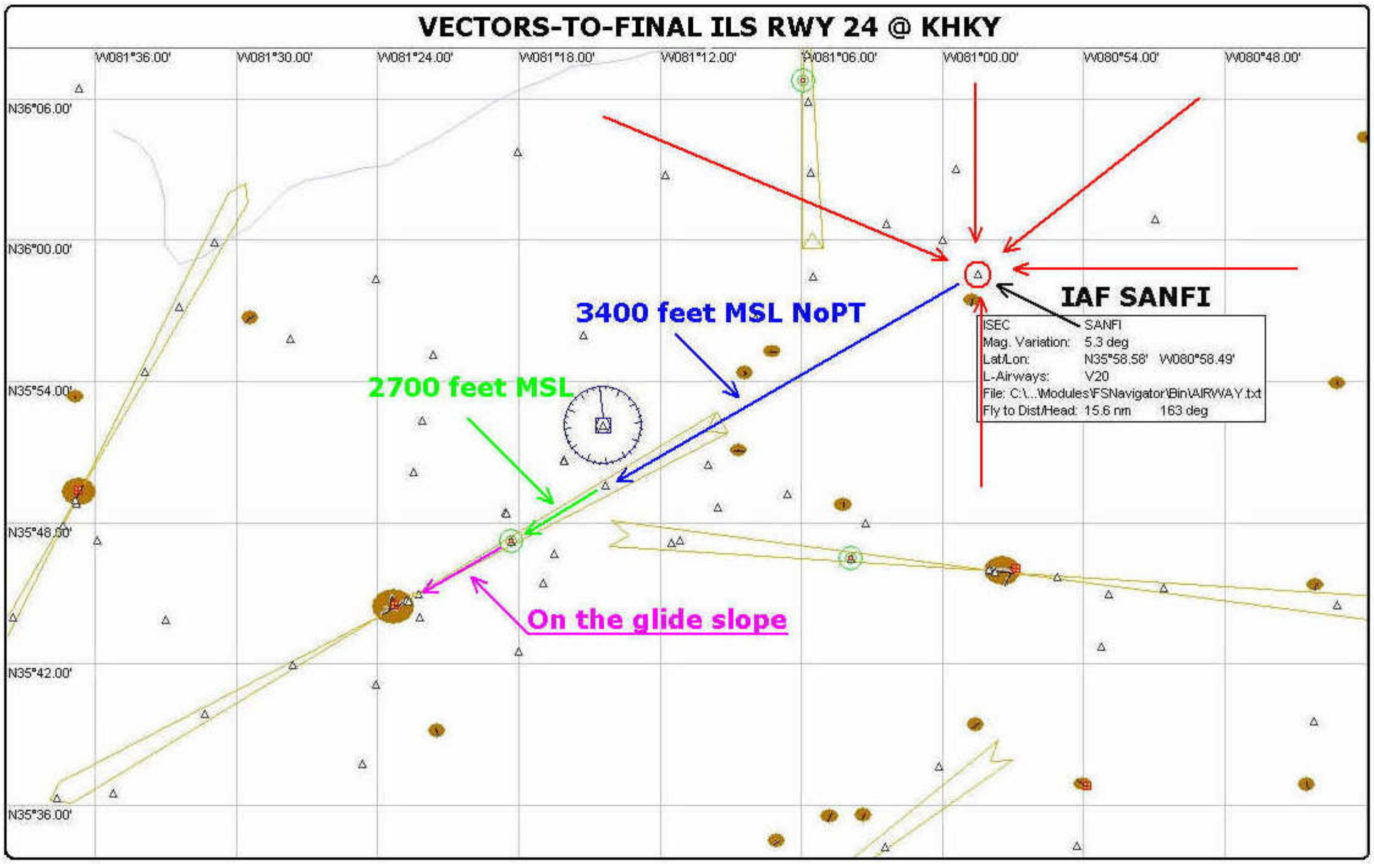


Figure 354 - Vectors-to-final using the SANFI intersection.

The online controller will guide the pilot to the SANFI fix from their current position (this can be from the point where the aircraft departs an airway the pilot was using en route). Using the actual approach chart the controller now does what the pilot would do. The controller would advise the pilot to turn to heading of 241° and descend to 3400 feet MSL at SANFI. The controller would provide any necessary vectors after the aircraft crosses SANFI to get on the blue line in figure 354. In this particular example the controller doesn't need to worry about the angle of intercept as the aircraft will be headed exactly on the localizer heading. The primary concern here is proper altitudes. After crossing the SANFI intersection and headed inbound for the final approach the controller may ask the pilot to report when established on the localizer. The controller can not see the pilot's navigation gauge so the pilot will need to tell the controller when s/he is tracking inbound on the localizer signal. As the pilot reaches Mirty intersection (where the blue line ends and the green line begins in figure 354) the controller can advise the pilot to descend to and maintain 2700 feet MSL until established on the glide slope. This is normally done in conjunction with providing the final clearance for the approach (remember this is not the landing clearance that is provided only by the tower controller!). Once the pilot reaches the FAF (TAWBA NDB) then the aircraft can safely start down the glide slope to the runway. The controller has basically used the approach chart to provide safe altitudes along the approach course just as the pilot would have done.

Again remember, the controller typically provides vectors and altitudes until clearing the pilot for the approach. The controller could have instead cleared the pilot as follows: "N9COF cleared direct to SANFI to conduct the ILS runway 24 approach, report established on the localizer." In this case the pilot will need to have the approach chart (as all good pilots should have handy, right? <grin>) and conduct the approach as published from the SANFI intersection (basically just like the online controller would do in the above example. It depends on how the controller issues the clearance, so pilots beware and keep those charts handy <grin>. *Remember, depending on pilot skill online controllers may deviate from real-world criteria to meet the activities needs.*

Now what if the controller were not using the SANFI intersection as the initial approach point? Let's make another example.

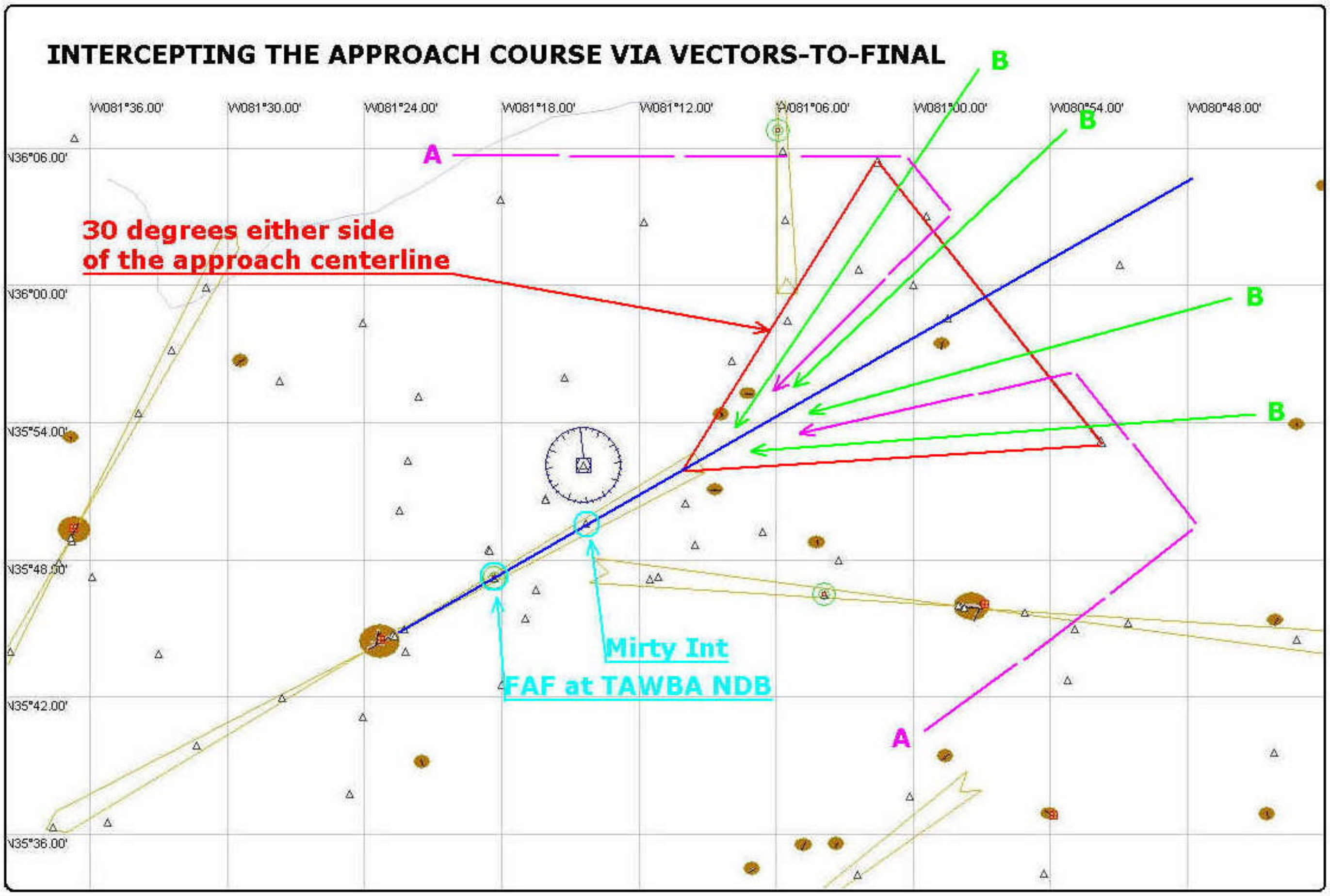


Figure 355 - Intercepting the approach course via vectors-to-final.

In figure 355 you'll notice the red triangle. This triangle depicts the maximum angle of intercept for the approach into runway 24 at KHKY when provided vectors-to-final by an online controller. Aircraft approaching from any of the locations marked by "B" (the green lines) can be brought straight in for the intercept. Any aircraft outside the allowed angle of intercept will have to be vectored to allow them to enter the triangle and then intercept the final approach coarse at less than 30°. In a case such as this, where no published procedure would exist, the controller can not clear the pilot for the approach until located inside the triangle headed in the general direction of any of the green or pink lines toward the localizer. Once that is accomplished the controller could clear the pilot to proceed on the final issued heading until established on the localizer. Typically the pilot will be receiving the localizer inside the red triangle if within approximately 15nm of the FAF (the same distance as the procedure turn limit imposed by a full approach).

Also note that the triangle was drawn from the end of the ILS feather as depicted on the FS Navigator map, the feather does not have a fixed scale depending on the zoom factor within FS Navigator. ***DO NOT*** use the end of the feather to judge the proper distance as it changes when zoomed in or out. In our case here a good rule-of-thumb is for the controller to establish the triangle somewhere very close to the 15nm limit. This way the safe altitudes depicted on the published approach will apply.

One last note before moving on, the GPS 500 allows the pilot to easily conduct a vectors-to-final approach. It works similar to this: When the pilot is initially handed off to the approach controller the approach controller will tell the pilot which approach to expect (in our case we'll say the ILS RWY 24 approach). At that time the pilot would select the ILS RWY 24 approach in the GPS using the PROC button. Then when it asks for the initial approach point (called the transition) load the vectors-to-final. Do not activate the approach just yet, *just load it!* Now let's say you are approaching from the south via point A on the pink line as depicted in figure 355. The controller is vectoring you along. When the controller has you turn to enter the red triangle a clearance may be issued as follows "N9COF turn heading 270° and descend to 3400 feet MSL cleared for the ILS approach runway 24 at Hickory." Now activate the vectors-to-final approach in the GPS 500. Make sure to couple the GPS to the autopilot. The autopilot will head directly for the approach centerline shown as a magenta colored line on the GPS map and intercept the final approach course *from the aircraft's current position*. The pilot would use the appropriate approach chart to maintain the altitudes as published for the remaining portion of the approach (*the controller will not provide the altitudes in this case because the pilot has been cleared for the approach and is expected to do that themselves at this point*).

Remember, once the controller clears the pilot for the approach the pilot (not the controller) is expected to properly conduct the approach. If you do deviate from the expected procedures the controller may question the pilot politely similar to this "N9COF I show you 200 feet below published minimums is there a problem?" It should never hurt one's feelings to have the added insurance of another set of eyes looking out for you.

It is incumbent of a pilot to know how to conduct the various approaches that may either be assigned by a controller or requested during landing. There is nothing worse than a pilot who is released to conduct an approach and then not do it as published. If you don't have the approach chart handy tell the controller who can guide you right up to the glide slope. The GPS is a good way to stay well within approach parameters once you get the hang of it. Use it until you are well versed in the various approaches and can try them using the traditional navigational aids.

THE ILS DECISION HEIGHT (DH)

The ILS approach is a PAP (Precision Approach Procedure). If you remember, the electronic glide slope component is what makes the ILS a *fully* operational PAP. *If the glide slope component fails then the ILS is no longer a PAP but becomes a non-precision localizer approach. If the localizer fails then the ILS approach is not authorized.*

There must be a way to reference the lowest altitude (ILS minimums) an aircraft is allowed to descend to so as to safely make positive visual contact with the runway. If positive visual contact can *not* be made at this designated altitude the pilot is required to execute a missed approach.

So, if the ILS is *fully* operational (*the localizer and glide slope are functioning*) then this altitude is referred to as the DH (Decision Height). Most all ILS approaches during online multiplayer activities are conducted as Category I approaches (Category II and III approaches in real-life require special crew certifications and equipped aircraft). Some complex modeled simulator aircraft can conduct a CAT IIIC autoland (for zero visibility landings). I'll provide examples of this shortly. In keeping with that the DH will typically always be 200 feet AGL (Above Ground Level) for a CAT I approach or 100 feet AGL where CAT II approaches are conducted. Note that the presence of an inner marker beacon on an approach is normally associated with a CAT II approach. The inner marker beacon typically marks the approximate point where the missed approach is executed just like the middle marker beacon marks the approximate point where the missed approach is executed during a CAT I approach.

During an ILS approach the DH is also the missed approach point (MAP). On aircraft properly equipped (including those in the flight simulator) there is an altitude "bug" (the bug is a movable indicator within the gauge) that can be adjusted on the altimeter or on a RA (Radar Altimeter) gauge to set an altitude where a light/aural warning is provided to the pilot when reaching the DH/MAP. In real-life no pilot is authorized to continue the approach below the DH based on several factors. The definition for DH is *the altitude where the pilot decides to continue the approach to touchdown or execute a missed approach.* So, for our purposes during online ATC activities the pilot can continue below the DH as long as they can maintain visual reference with the runway itself in the simulator. Example screenshots are provided shortly to help you understand this acquisition of the runway.

Now, what if the glide slope component fails? This will probably never happen in the simulator but I'm going to discuss this because it will be similar to conducting the non-precision approaches to be discussed next. With this condition present the altitude is referred to as the MDA (Minimum Descent Altitude). The definition of MDA is the altitude expressed in MSL (Mean Sea Level) to which descent is authorized on final approach or during circle-to-land maneuvering in execution of a standard IAP *where NO electronic glide slope is provided (a non precision approach)*.

Now that we have explained the difference between the DH, MDA, and MAP we need to know how to determine what they are for the approach we need to conduct, so back to the approach chart.

On the chart is a small table of sorts that depicts aircraft approach categories A through D (aircraft approach categories are based primarily on aircraft weight and speed, A being smaller aircraft while D is the heavies) Helicopters are considered Category A aircraft. The rows in the table continue with labels depicting the condition of the approach. In figure 356 you see the first line in the table on this chart is for S-ILS 24. This line provides the minimums for a fully operational straight-in ILS approach to runway 24 at KHKY.

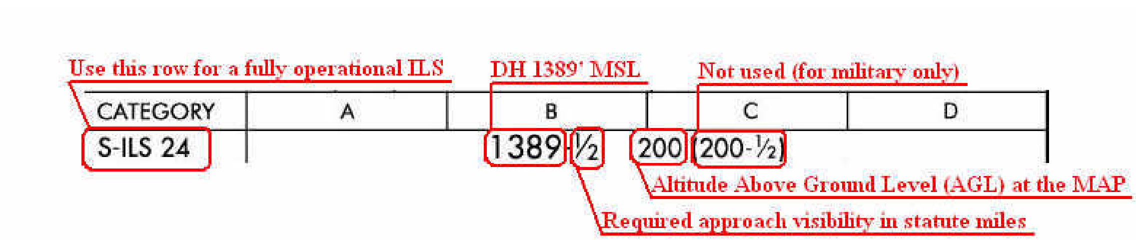


Figure 356 - Reading approach minimums for the full ILS approach.

The minimums on this particular line apply to all categories of aircraft (A through D). The DH shown in this line (1389 feet MSL) is 200 feet AGL at the MAP. Do not worry about the "200 - ½" in parentheses, it is for military aircraft only. The DH is 1389 feet MSL (subtract the airport altitude of 1189 feet MSL from 1389 feet MSL (the DH/MAP) and you get the 200' AGL). The ½ shown just after the 1389 is the required reported visibility for the runway *in statute miles.* The example screenshots of the ILS landing shown later depict ¼ mile and 1/8 mile visibilities, far below that required to legally conduct this approach.

If the glide slope is inoperative and only the localizer component of the ILS is working (again this won't happen in the flight simulator) then the pilot is restricted further with a new set of minimums indicated by the row labeled S-24 in figure 357 (*you can always simulate the glide slope failing and conduct the approach per the glide slope "inop" minimums*). During a localizer only approach the aircraft is not to descend below an MDA (remember the altitude is now referred to as MDA if it becomes a non-precision approach) of 1560 feet MSL (that is 371 feet AGL at the MAP) and ½ mile visibility for category A through C aircraft. Category D aircraft have the same minimums except the visibility is increased to ¾ statute mile.

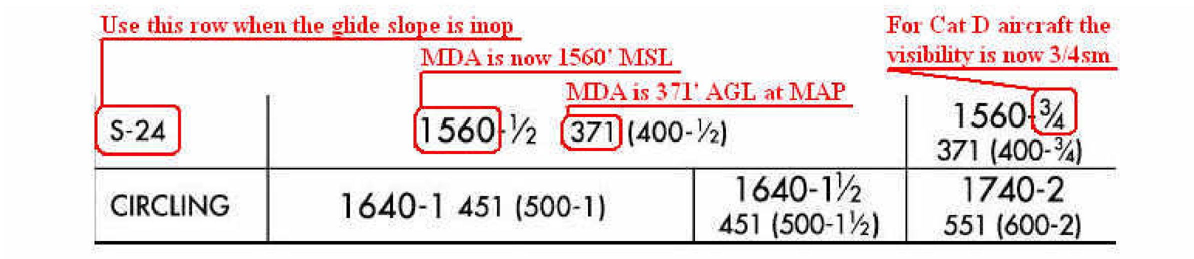


Figure 357 - Reading minimums for an inoperative glide slope.

Circling approaches are where the pilot conducts the instrument landing procedure (in this case the localizer approach) to safely descend to the airport but circles while maintaining visual contact with the runway and airport environment at a specified MDA to land on another runway. In other words this procedure allows the pilot to approach the airport using the localizer then circle to land on another runway at the circling MDA of 1640 feet MSL which is 451 feet AGL above the airport terrain. The pilot must at all times during the maneuver be able to see the airport and runway environment. Reported visibility must be at least 1 statute mile.

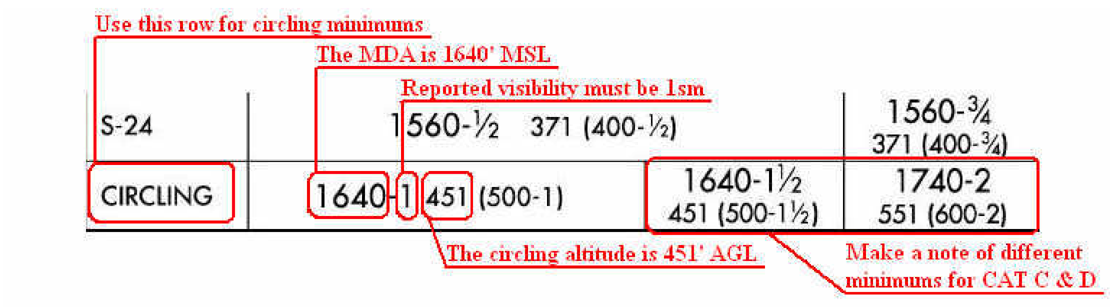


Figure 358 - Reading the minimums for a circling approach.

THE ILS GLIDE SLOPE

So, let's return to the point where the aircraft is intercepting the glide slope (at the FAF). The aircraft should be flying level at 2700 feet MSL BEFORE reaching the FAF. The aircraft should actually intercept the glide slope flying level from underneath see figure 359.

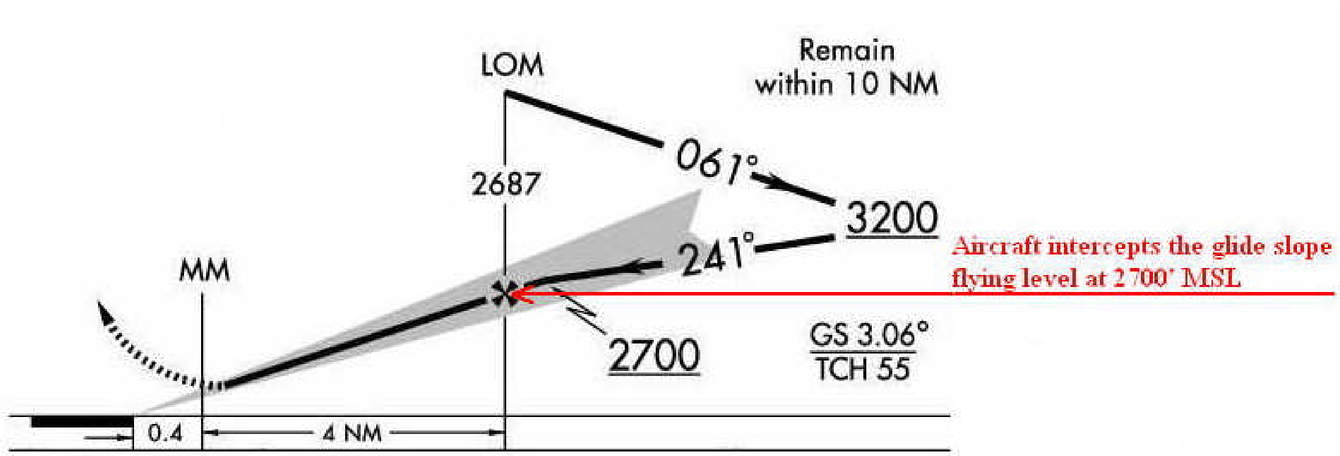


Figure 359 - Intercepting the glide slope from underneath.

The gauge being used should show the glide slope indicator pegged at the top when approaching the FAF. As the aircraft approaches this point the glide slope deviation indicator will move from the top down until centered horizontally as depicted in figure 360 by the small yellow arrows you see near the 150 and 330 compass heading points.

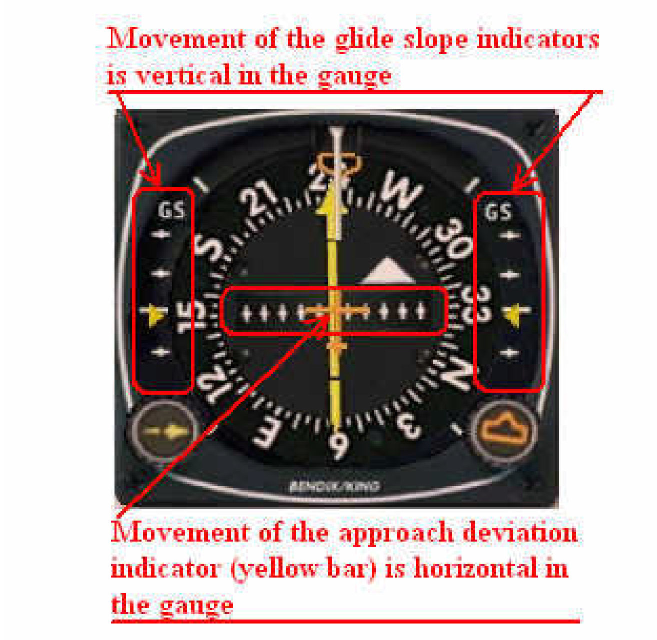


Figure 360 – Localizer and glide slope deviation indicators.

When both indicators (glide slope and approach path) become centered it is the job of the pilot (or autopilot) to keep them there during the descent phase of the approach. Under no circumstances should the aircraft be permitted to go below the glide slope once intercepted (the arrows used for the glide slope deviation will move back toward the top if flying below the glide slope).

Another problem pilots run into while on the glide slope is "chasing" the indicators. Why, because as the pilot descends the gauge will become more "sensitive" to the radio beam as the tolerance for error narrows when closer to the runway threshold, reference figure 361.

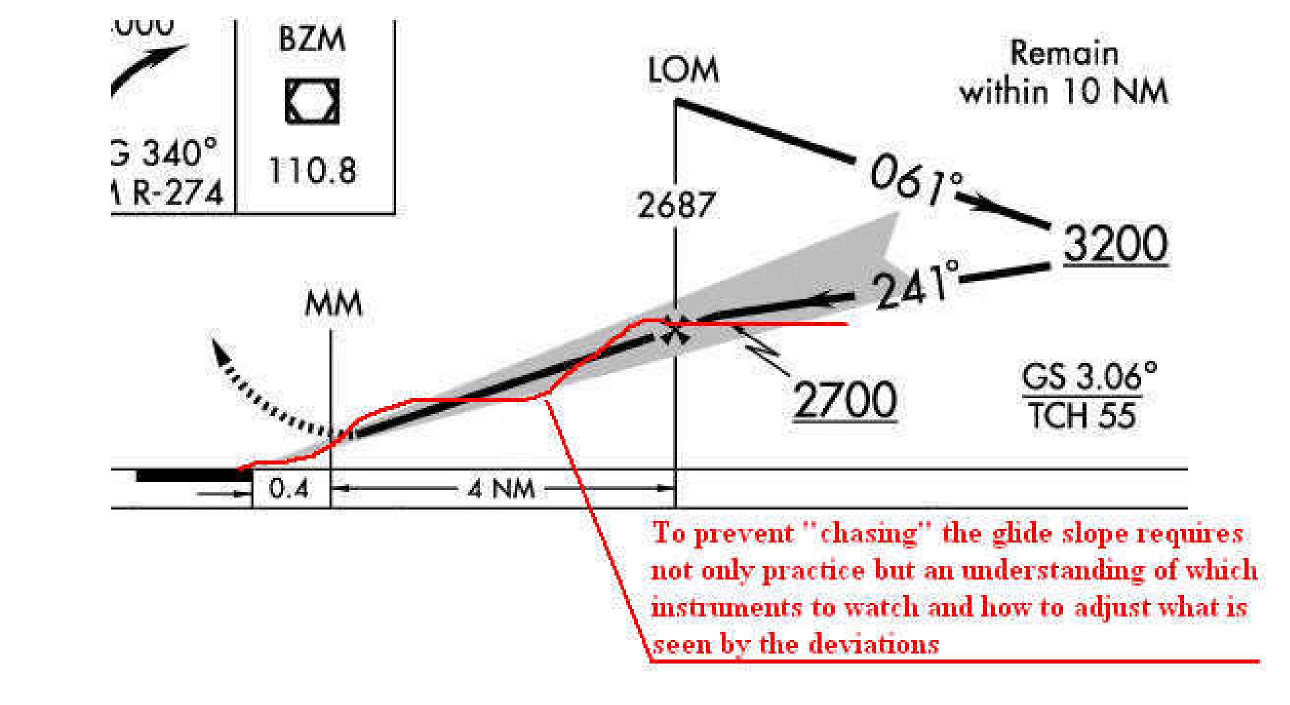


Figure 361 - "Chasing" the deviation needles during an approach.

Remember, the ILS localizer and glide slope are very accurate and will guide the aircraft to a point smack on the center line of the runway and in the "touchdown zone" if flown properly. "Chasing" is usually from inexperience because the pilot uses the stick to chase the indicators going down the slope (Be warned this technique is extremely opinionated among various pilots <grin>). Experienced pilots learn to stabilize the aircraft (gear down and flaps extended) at a constant rate descent using primarily power to control the descent rate along with very small stick movements. Once this technique is perfected pilots find that approaches go much more smoothly. Watching the vertical speed indicator during approaches for trends, keeping the aircraft in a stabilized constant rate of descent (typically around 600 to 800 feet per minute depending on aircraft category), and a stable angle-of-attack will make for perfect approaches if flown by hand.

Let me make a note about the autopilot here. If using the autopilot in the flight simulator the aircraft (in this case) should be at 2700 feet to properly engage with the glide slope. In real-life if the pilot allows the aircraft to get to high during the intercept there is the possibility of intercepting false signals from the ILS transmitter (better technology today makes this unlikely) but the fact remains proper intercept altitude makes a smooth and safe transition to the glide slope. Getting to low is not a factor when it comes to receiving improper signals, it is purely a safety factor. Always watch for the autopilot ALT indicator to go out when intercepting the glide slope (it should if everything happens correctly). If the autopilot doesn't immediately disengage the ALT button when intercepting the glide slope then "punch it off" and take over the descent manually and be aggressive about getting back on the glide slope.

Okay, moving on, I need to mention one last aspect about the DH. You're coming down the glide slope and everything is going perfectly and you reach the DH but you can *not* make positive visual contact with the runway, now what? Well, time to earn the big bucks!

THE ILS APPROACH VIEW

Look at some of these pictures during a practice approach with weather at ¼ mile visibility in the default Beech Baron 58. In figure 362, just above the DH (remember the DH is at 1389 feet MSL) you can just see the runway approach lights and just to the left the airport beacon light. Expand any of the following pictures to get a better view.

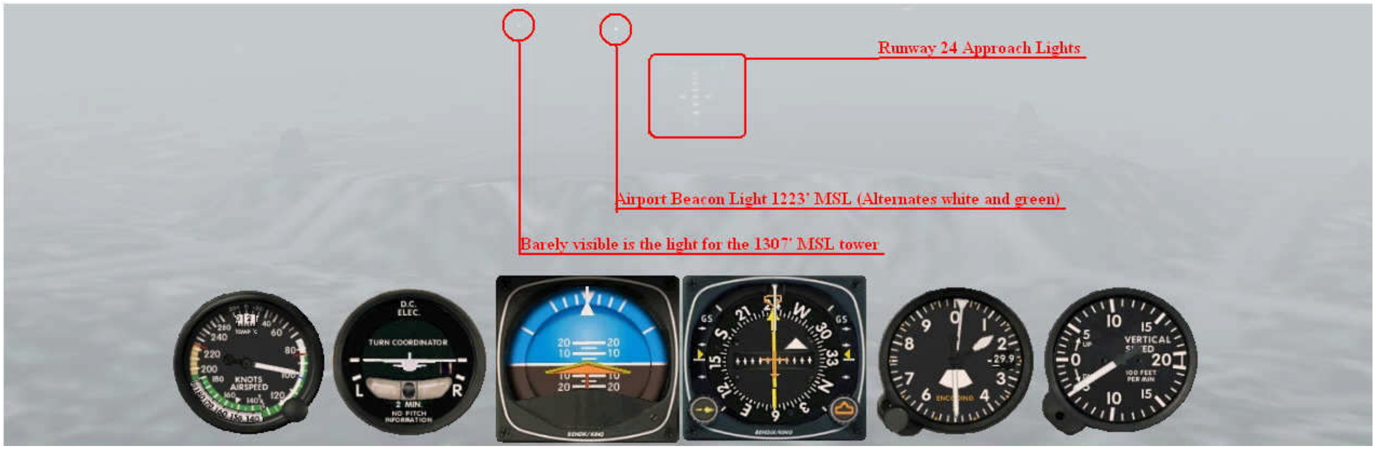


Figure 362 - Just above the DH (1389 feet MSL) at 1500 feet MSL.

In figure 363, right at the DH positive visual contact with the runway is made. The only tower light visible is the airport beacon light. Remember, the approach lighting system is used to guide the pilot's eyes to the runway, *not to continue the landing without sight of the runway by using the lights*.

Figure 363 - Visual contact with the runway approach lights and runway at the DH.

The chart helps with recognizing local airport obstacles. Notice in figure 364 the towers scattered around the airport area. At the DH you don't have much allowance for error. The highest points in the immediate airport area are (all are given in feet MSL) 1204, 1206, 1223 (the star indicates this is the airport light beacon), 1251 (the square block indicates this is the control tower), 1266, and the highest tower 1307 feet MSL (very close to the end of the runway). Remember, the MDA is 1389 feet…that is only an 82 foot difference from the highest obstacle shown. Again, understand the importance to *arrest your descent* if you can not make positive visual contact with the runway!

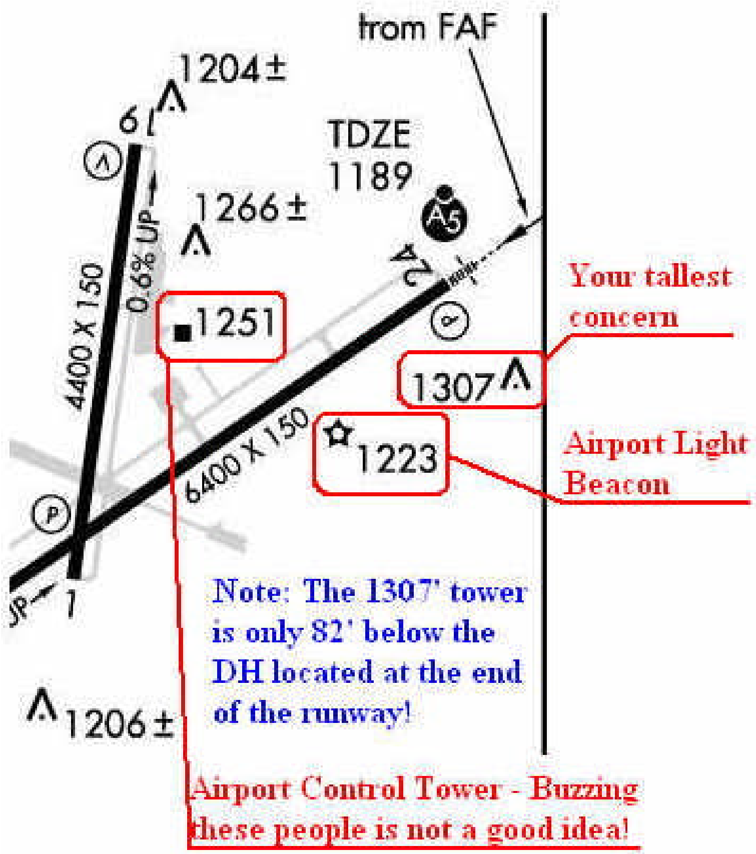


Figure 364 - Local airport obstacles shown on the airport chart.

In figure 365 just before touchdown the towers depicted in the approach chart become visible. At 1250 feet MSL you are in harm's way if you could not see where you are going. Notice the airport control tower at the right (1251 feet MSL).

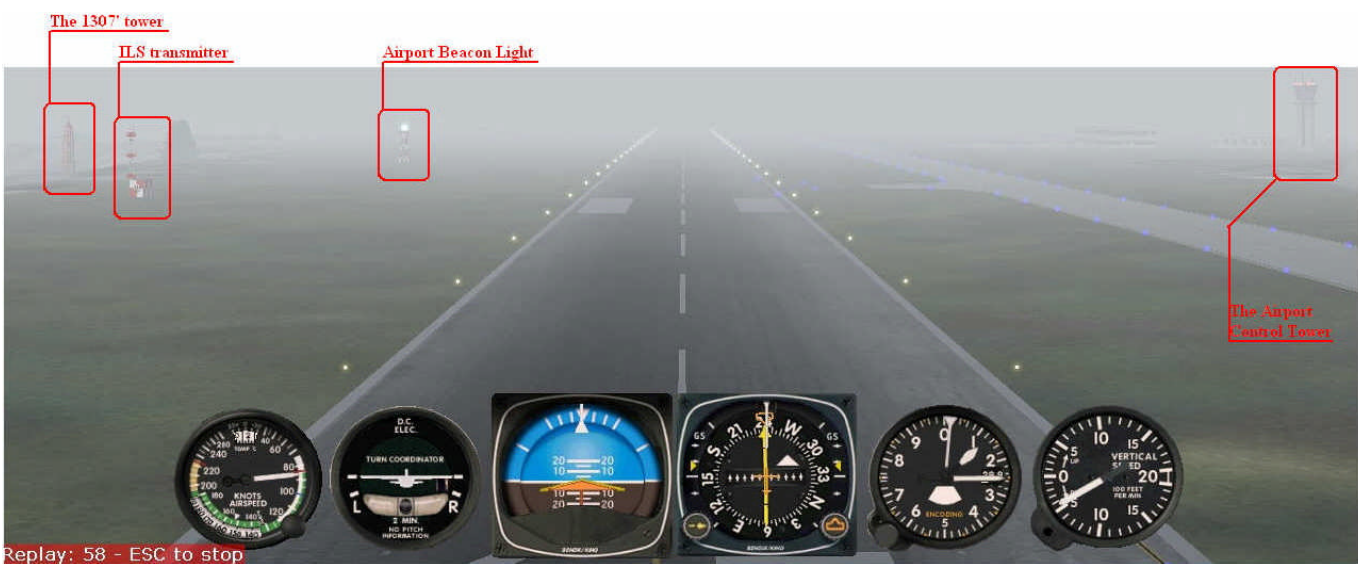


Figure 365 - Just before touchdown.

Now let's view the same approach with visibilities down to 1/8 of a mile. In figure 366 compare it to figure 362 above at 1500 feet MSL. Do you see the airport beacon light? Where did the terrain go?

Figure 366 - View at 1500 feet MSL with 1/8 mile visibility.

Figure 367 is at the DH as in figure 363 above and should be considered a missed approach. No positive visual contact with the runway can be made in this shot. Remember, you must make positive visual contact with the runway surface, *not* just the approach lights. *The approach lights are only a tool to guide your eyes to the runway surface (and threshold) which you must* ***acquire visually*** *at the DH*.

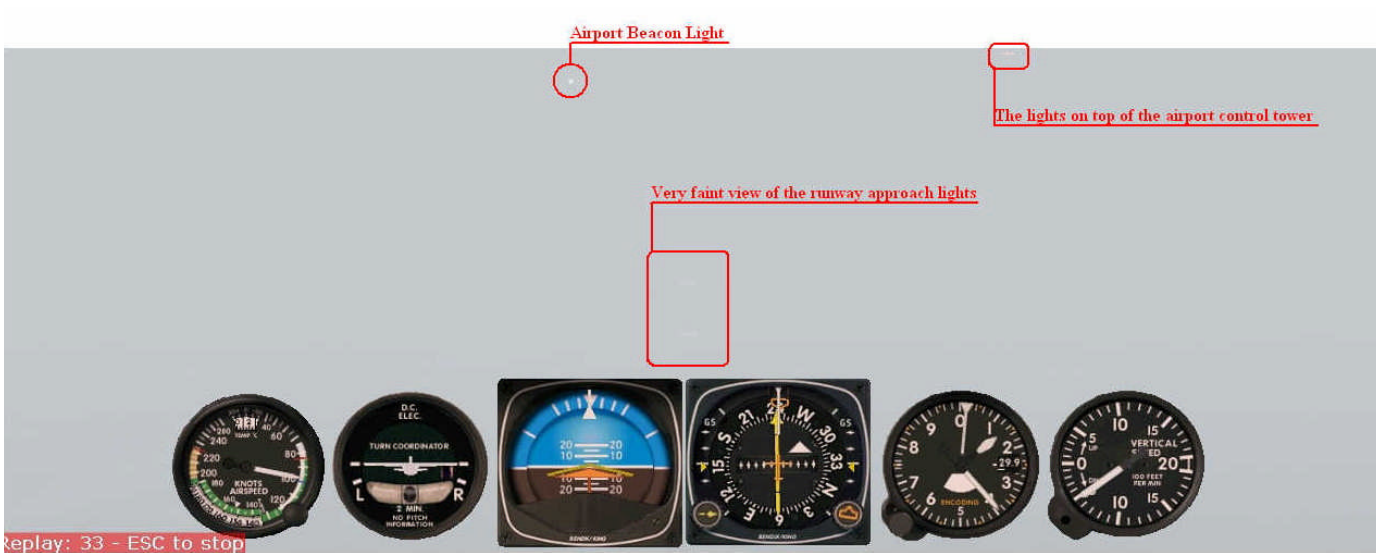


Figure 367 - At the DH with visibility at 1/8 of a mile.

Remember the 82 foot difference we discussed above in figure 364. At 1300 feet MSL depicted in figure 368 you are 89 feet below the DH, an altitude that could let us rake over a few things unseen. You can barely make out the green runway threshold lights just above the simplified gauges. This is where CATII/III landings would be required by specially certified flight crews and aircraft to land the aircraft safely.

Figure 368 - This view is at 89 feet below the DH in 1/8 mile visibility.

Even after landing on the runway the towers can not be seen due to poor visibility.

Figure 369 - After landing in 1/8 mile visibility nothing can be seen in the airport environment.

TIPS FOR PILOT AND CONTROLLER DURING AN ILS APPROACH

The following discussion is an outline of events that could be expected to occur during an online activity while conducting an ILS approach for the KHKY chart discussed. Parts preceded by "Controller" are events or things the controller will primarily be concerned about during the approach but important for the pilot to understand and vice-versa for those preceded by "Pilot". Our enjoyment of online ATC activities will be better if both pilot and controller work from the same information (the charts in this case) just as they would in reality.

Controller - When an aircraft is passed from the last center to the approach controller that controller's procedure is to advise the pilot once below FL180 of the correct altimeter setting. When pilots are flying at or above FL180 all aircraft altimeters are set at standard pressure (29.92), so when they descend below this altitude the controller must ensure they have the current setting. Also during the descent the controller will let the pilot know in advance what the expected approach will be for landing (*In real-life the pilot would normally listen to the airport ATIS frequency when in range of it to get vital information and the controller supplements this information*).

Pilot - This information provides the pilot ample time to setup the instruments and radios for the landing. Think ahead of your aircraft, and you won't get behind preparing for the landing. Have your approach charts ready for the runway ATC assigns for landing. That is why it is so important to do the preflight planning. It's too late to go looking for this information when starting into the approach, but of course, if you ask, the online controller is normally more than willing to give you the information as they should have this information during the activity <grin>. If a pilot is experienced and doesn't have to ask then things will progress smoothly (and more realistically), but ATC will help you! Remember, stay ahead of the game by thinking ahead of your aircraft.

Controller – Looking at figure 370 the controller will notice a circle in the top-down view of the chart in the lower right hand corner with MSA (Minimum Safe Altitude) HK 25NM wrapped around it.

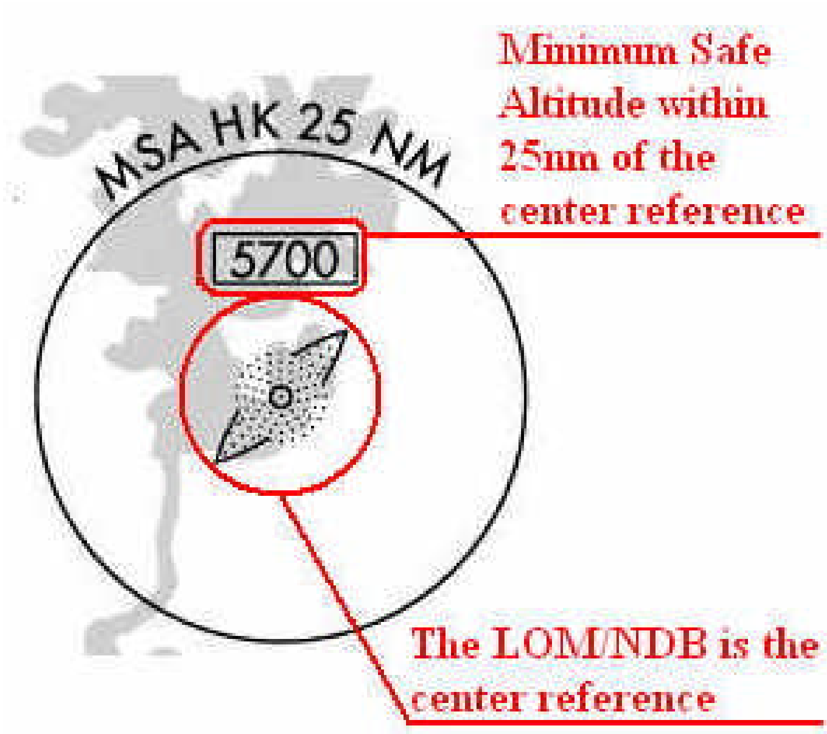


Figure 370 - Minimum safe sector altitude.

In the circle is the altitude 5700 feet MSL (Mean Sea Level). That is the MSA on this chart for aircraft approaching from ANY direction within a 25 nautical mile radius of the FAF (Final Approach Fix).

Some circles are divided like a pie depending on the surrounding terrain as in figure 371.
If the aircraft is located within 25nm of the LOM/NDB in the blue sector and the aircraft is approaching the LOM/NDB with a heading displaying any direction between 270° and 360° the

minimum safe altitude is 5600 feet MSL. If the aircraft is located within 25nm of the LOM/NDB in the green sector and the aircraft is approaching the LOM/NDB with a heading displaying any direction between 001° and 269° the minimum safe altitude is 7800 feet MSL.

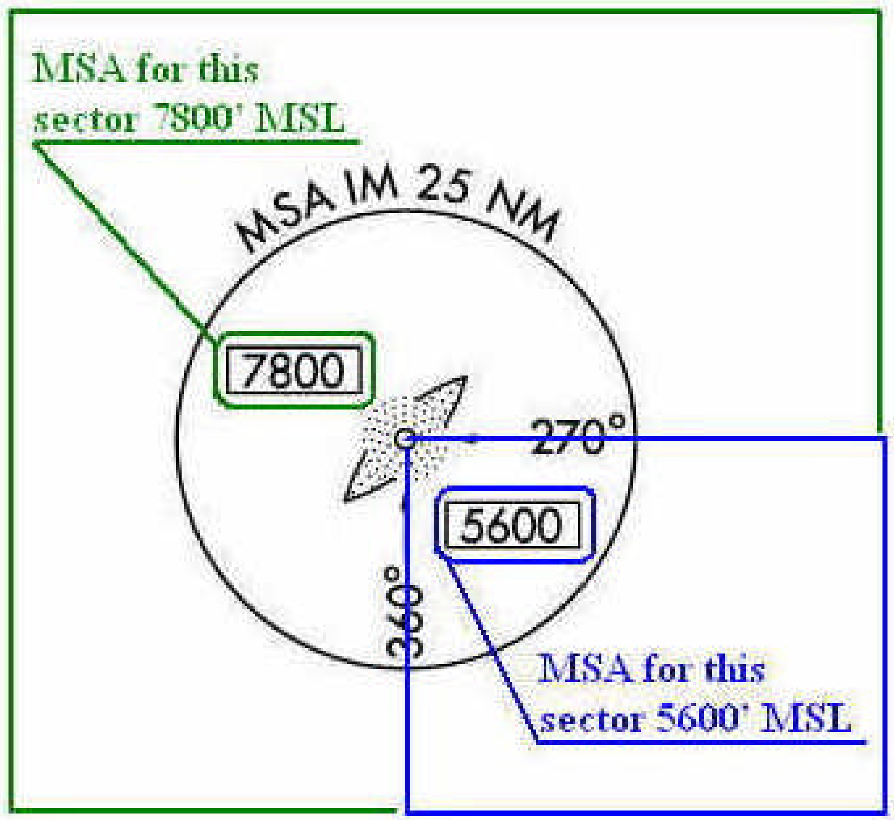


Figure 371 - Minimum safe sector altitudes.

Note: Figure 371 is taken from the chart for KAVL ILS RWY 16. Not from the KHKY ILS RWY 24 chart.

This circle tells the pilot "at-a-glance" in an emergency situation the minimum safe altitude the aircraft must be maintained at to stay clear of obstacles and terrain located within 25nm of the FAF. For our approach this MSA is 5700 feet MSL from any direction (reference figure 370).

Well, we all know FS Navigator is notorious for not readily displaying MSA altitudes, so how can we put this information to good use? By using the controller's capability to measure distance in FS Navigator they can setup points within given distances to keep pilots at a safe altitude. Pilots who have enhanced their flight simulator using new terrain mesh add-ons will want to pay close attention to this as ground terrain is more accurately depicted.

Let's make a practical example. Find the IAF (Initial Approach Fix) SANFI in the top down view on the chart near the upper right, see figure 372. It is located 13.3 nautical miles DME (Distance Measuring Equipment) from the BZM VOR (Barretts Mountain) navigation transmitter.

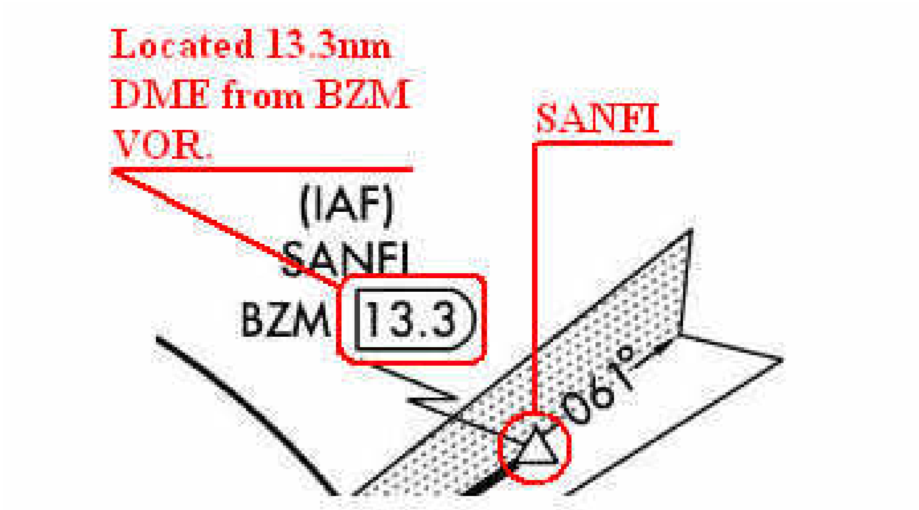


Figure 372 - The IAF SANFI.

Under this you will see a note "3400 NoPT to Mirty Int 241° (14.5)", reference figure 373. This note is telling the pilot s/he can approach straight in from this IAF on a heading of 241° *without* conducting the procedure turn (or in other words the full approach) at an altitude of 3400 feet. The aircraft is not to descend below 3400 feet MSL until reaching Mirty intersection. The distance between SANFI and Mirty intersection is 14.5nm (note this distance is *not* a DME distance as shown in figure 372).

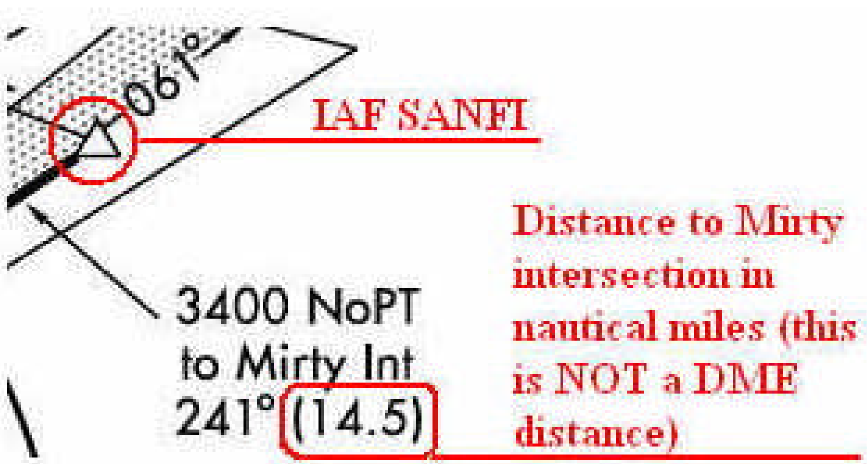


Figure 373 - Notes for the approach starting at SANFI intersection.

Once reaching Mirty intersection it is safe to descend to 2700 feet MSL until reaching the LOM (Localizer Outer Marker) where the pilot intercepts the glide slope and can start the descent to the runway, reference figure 374.

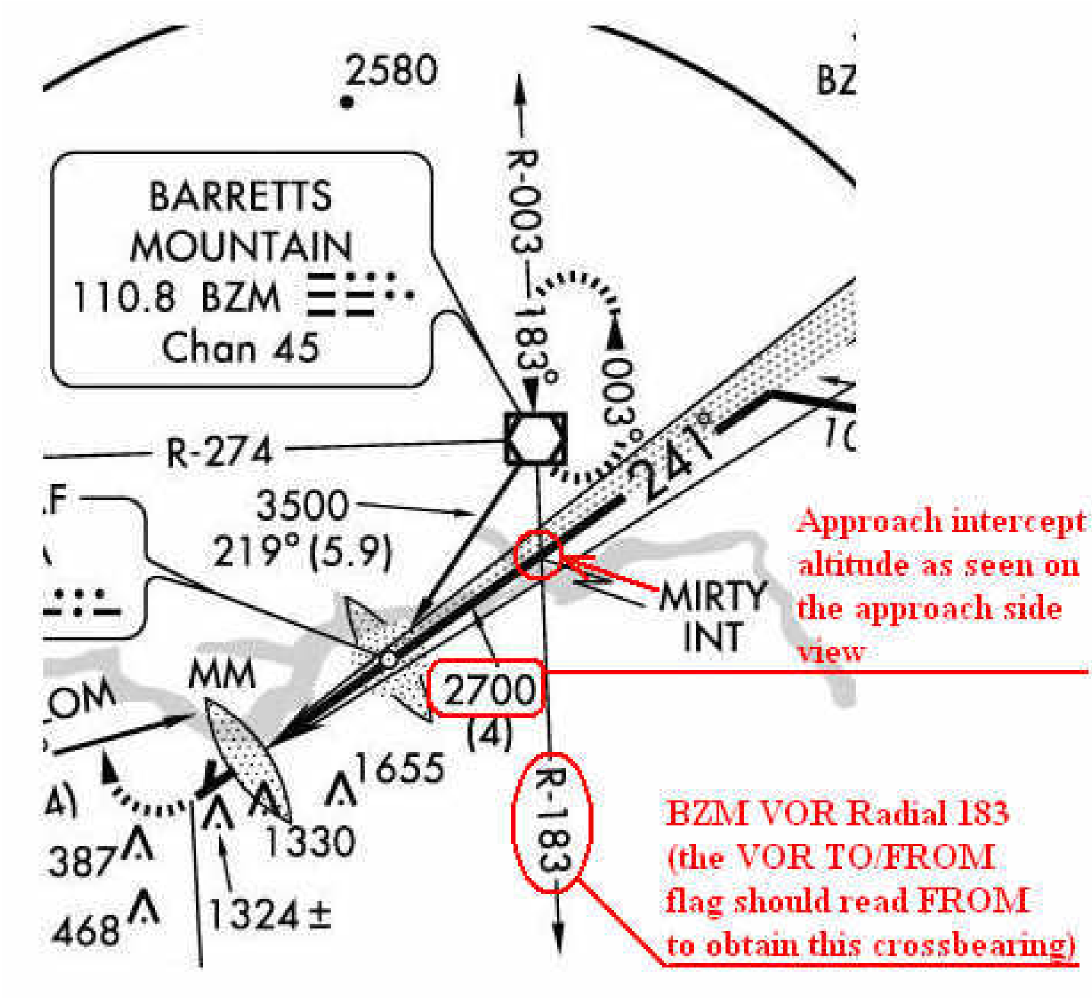


Figure 374 - Identifying Mirty intersection.

So, I as a controller could use the IAF SANFI (that can be easily located in FS Navigator) as my initial point to start this ILS approach and provide safe altitudes just as the pilot would if using this chart. Typically the approach controller should clear the pilot to conduct the approach at the IAF SANFI. From there the pilot would be able to conduct the approach procedure per this chart.

Pilot – Okay, the approach controller vectors the pilot down to a safe altitude (in this case using the MSA 5700 feet MSL within the 25nm radius of the TAWBA NDB) and to a point (we'll use the IAF SANFI in this example) where the aircraft is traveling in a straight line toward a line protruding from the center of the runway not greater than a 30° offset (less is better). This ensures a smooth transition to the inbound approach path without unusual maneuvering. *Some autopilots will not engage the localizer properly if the intercept angle is too great*. To get a better idea of the intercept look at figure 375.

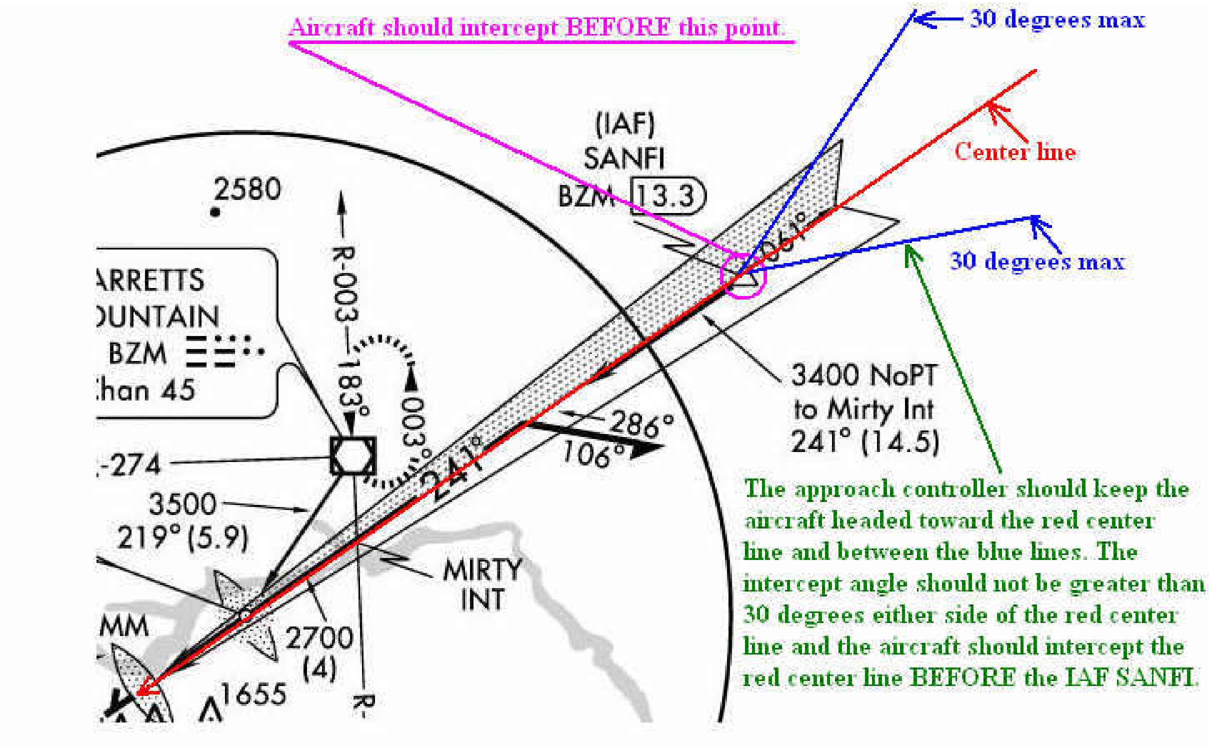


Figure 375 - Intercepting the ILS localizer via vectors-to-final.

Controller - Just *before* the aircraft reaches the IAF SANFI the approach controller should clear the pilot for the ILS approach (the approach controller does *not* clear the pilot for landing, only the ILS approach itself, *only* the tower controller clears the pilot for the landing). The approach controller will also provide the frequency for the tower controller for the pilot to switch to at this point. Tower should be in contact and responsible for the aircraft from this point until clearing the runway after touchdown.

Pilot – The pilot should contact the tower immediately (delays are not good) and advise the tower when the aircraft is established on the localizer which should be within radio range at this time. The pilot will not be established on the glide slope until reaching the LOM/FAF. The localizer is only the path to the runway. The glide slope is the descent to the runway. The glide slope indicator should still be pegged at the top of the gauge until reaching the FAF (if not you're already in trouble <grin>).

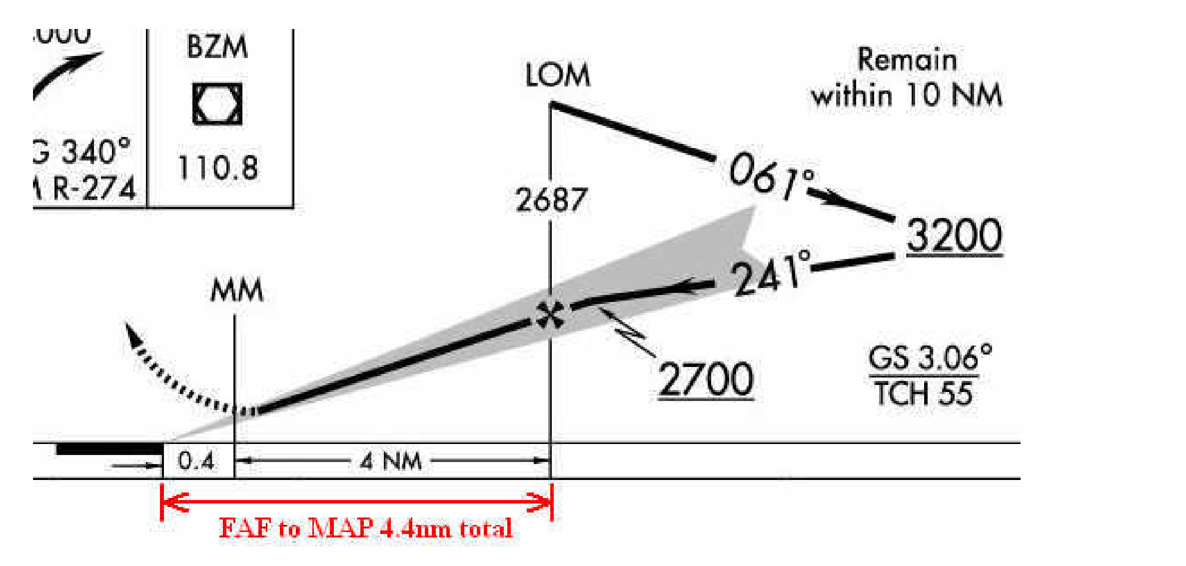


Figure 376 - Distance from the FAF to the MAP on the profile view.

Controller – The tower controller may tell the pilot just after contact but *well before* reaching the FAF, to "report reaching the outer marker". If you look at the approach profile view (reference figure 376) the distance from the FAF to MAP is 4.4nm, the distance from the runway threshold to the middle marker (.4nm) plus the distance to the outer marker (4.0nm) for a total of 4.4nm. This distance is also pointed out in other locations on the chart such as in figure 377.

Distance between the FAF and MAP

FAF to MAP 4.4 NM					
Knots	60	90	120	150	180
Min:Sec	4:24	2:56	2:12	1:46	1:28

Figure 377 - Distance from the FAF to the MAP.

Also note the row for Knots and the row for minutes and seconds. This is the precalculated time for an aircraft traveling at the various indicated airspeed (IAS) to reach the MAP from the FAF (used primarily during non-precision approaches). Ever wonder why the chronographs (stop watches) are still in the aircraft? More about using the chronographs soon.

Pilot - How does the pilot identify the approach markers (sometimes referred to as the "fan" markers)? If the approach has an OM (Outer Marker), MM (Middle Marker), and IM (Inner Marker) then the pilot can receive information visually and aurally when passing the markers by the cockpit marker beacon light indicators and the audio panel (reference figures 378 and 379). The OM is blue, the MM is Amber, and the IM is white.

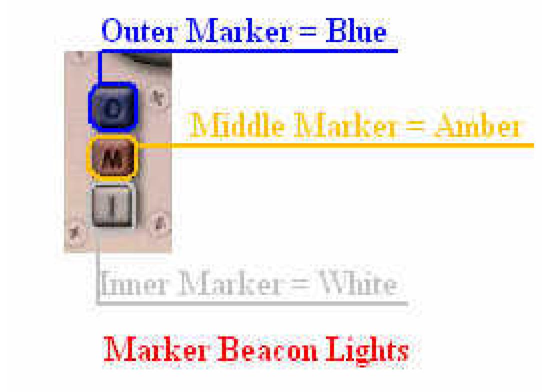


Figure 378 - Marker "Fan" Beacon light indicators.

As mentioned the middle marker beacon is typically associated with a CAT I approved precision approach and typically coincides with the location of the DH/MAP (usually at an altitude 200 feet AGL on the descent). An inner marker beacon is typically associated with a CAT II approved precision approach and typically coincides with the location of the DH/MAP (usually at an altitude 100 feet AGL on the descent). CAT III A/B landings will take a pilot to 50 feet AGL on the descent to the DH/MAP. CAT IIIC landings will not have a DH because it provides for a zero landing visibility all the way to touchdown.

The pilot can hear a unique audio tone for each beacon if the pilot turns on the audio for the marker beacons (typically labeled MKR on the audio panel). In figure 379 the audio for the voice communications radio (COM1) and the marker beacon audio (MKR) are shown turned "ON". This is the preferred method of identifying the marker beacons during an approach. The pilot is typically to busy watching critical instruments with his/her eyes so merely hearing the audio is good enough.

Figure 379 - Cockpit audio panel with the marker beacon audio switched "ON".

Note the following indications a pilot gets when passing over a marker (fan) beacon.

MARKER	CODE	LIGHT	AUDIO
Outer Marker (OM)	Two dashes per second	Blue	400 Hz
Middle Marker (MM)	Alternate dot and dash	Amber	1300 Hz
Inner Marker (IM)	Only dots	White	3000 Hz

These help the pilot realize when reaching a specific point on the approach. The ILS approach to runway 24 above has two of these marker or "fan" beacons present, the LOM (or Outer Marker) and MM (Middle Marker); reference figure 380 and 382.

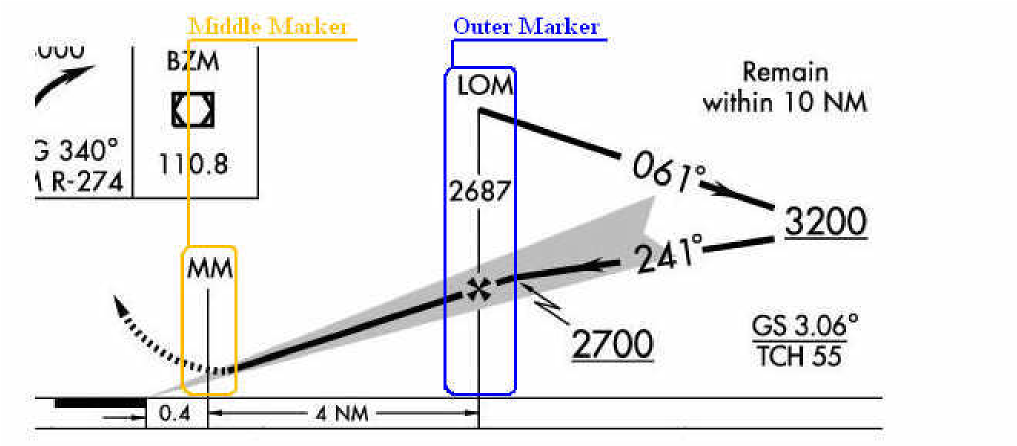


Figure 380 - The KHKY ILS RWY 24 outer and middle markers.

On the top-down view of the approach chart marker beacons are indicated by symbols that look like ellipses.

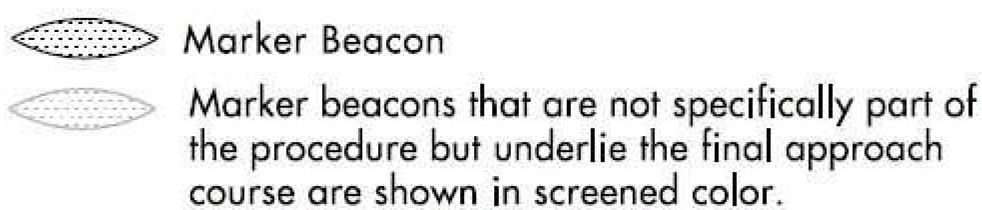


Figure 381 - Marker "Fan" Beacons.

There is no inner IM marker beacon on the KHKY RWY 24 ILS approach.

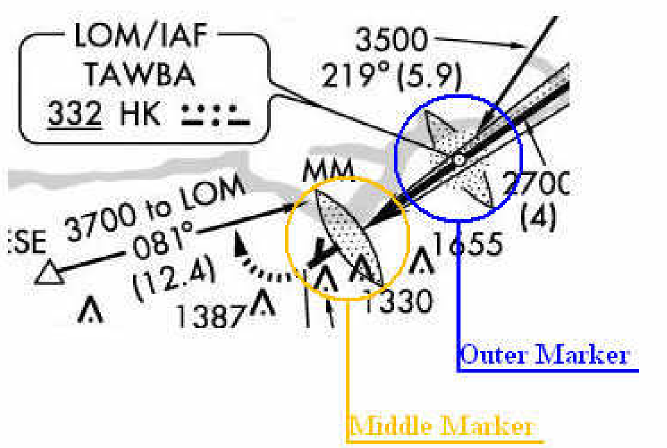


Figure 382 - The marker beacons depicted on the top-down view.

Important, realize that the marker beacon signals are narrow. The signal is “focused” so you must pass within a given area directly above the marker beacon before the visual and audio indications will be activated. The signal would look like an ice cream cone with the point of the cone at ground level. If you do not pass through the cone then no visual or audio indication is received such as being to far off the approach path.

Another important note here, as mentioned before the outer marker or “fan” is co-located with an NDB (Non-Directional Beacon) at this airport, NDBs are navigational aids of days-gone-bye-bye. Still used in many places for various reasons (economics mainly, they're cheap) they provide a crude but reliable homing capability. The cockpit ADF (Automatic Direction Finder) receiver can be tuned to the NDB transmitter by dialing in 332 (the Morse code identifier is HK in the top down view located where the info box is for the LOM) as in figure 383.

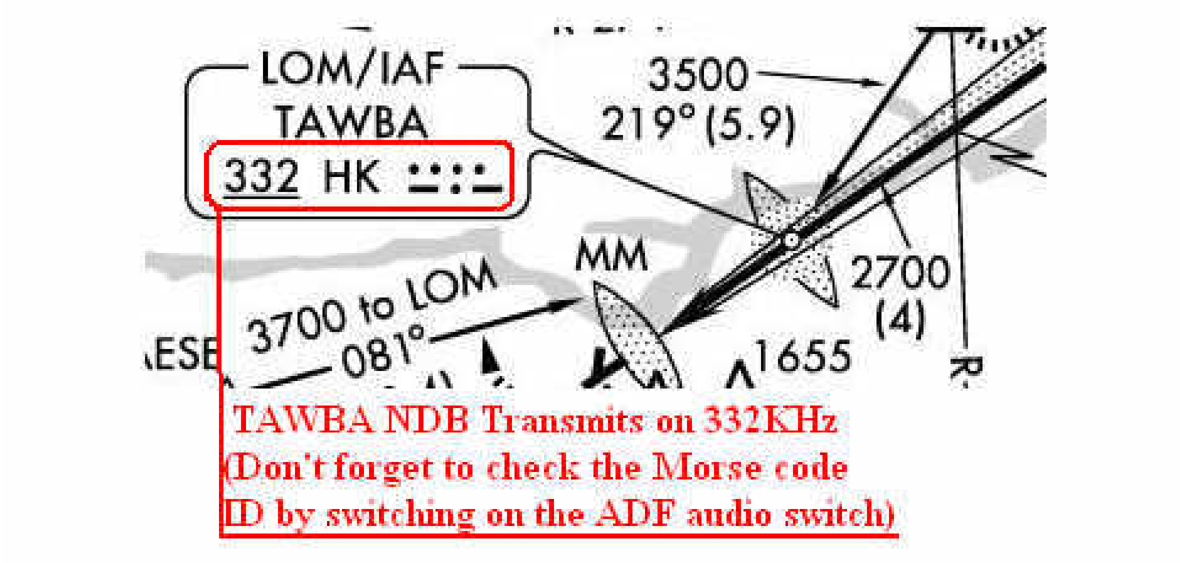


Figure 383 - The NDB frequency and Morse code identifier.

If you tune this frequency into the ADF receiver the indicator arrow on the ADF gauge will point to the NDB transmitter at all times when within range. Note that if the gauge is a typical ADF gauge such as in the default Cessna 172 the compass rose must be *manually* set to the same direction shown on the directional gyro (DG) to obtain proper headings using the HDG knob.

Figure 384 - Typical ADF gauge (the compass rose on this ADF gauge must be set manually).

If the aircraft is equipped with an RMI (Radio Magnetic Indicator) the RMI gauge has a compass rose that automatically rotates and is always aligned in the direction the aircraft is traveling (the same direction shown on the directional gyro (DG). When the compass rose in the RMI is coupled to the DG in this manner it is referred to as being "slaved" or "caged". An RMI gauge is shown in figure 385 and the indicator needles can be coupled to different navigation sources thus providing a constant bearing to the transmitted source in relation to the aircrafts position. In figure 385 the ADF indication is provided by the yellow arrow (note the switch position in the lower left of the gauge that selects the source signal to be pointed at by the arrow). The green (double bar) arrow is coupled to the VOR2 signal (*note that the sources on some flight simulator RMI gauges are fixed and are not selectable as* *in the default Baron 58*). In figure 385 the aircraft is traveling 175°, the bearing to the NDB is 235°, and the bearing to the VOR is 230°.

Figure 385 - Radio Magnetic Indicator (RMI) gauge.

One final note, if you ever get lost (heaven forbid <grin>) this instrument is one of the quickest ways to locate yourself if you don't have all the new fancy navigation aids such as GPS and such. By tuning two specific signals, reading the bearings, and looking on a VFR or instrument navigational chart, you can cross the bearings to the sources and find your approximate location (at least good enough to get you out of hot water <grin>).

Note that when the aircraft crosses the NDB location during the ILS approach discussed the needle will swing from a point toward the nose of the aircraft to a point to the rear of the aircraft (the top of the gauge is typically considered the nose of the aircraft and the bottom of the gauge the rear of the aircraft). For further information on tracking NDB transmitters reference chapter 3 "Navigation by NDB". In this example here it is nothing more than a backup for identifying when passing the FAF.

Controller – Now what is all this fuss about reporting the outer marker I mentioned recently? Well, that is the point where the tower controller should make a final check for a clear runway (everyone is holding short for a landing aircraft right? The runway is clear of aircraft right?). When the check is complete the controller provides the pilot clearance for landing on the runway. The pilot can *not* land without this clearance. Even if the controller forgets to clear an aircraft for landing the pilot *must* execute a missed approach and go around by the time they reach the MAP whether they see the runway or not. On the other hand let me give the pilot a hint, the pilot can politely inquire to the controller about whether clearance to land is granted and that will usually do the trick <grin>. Be aware not all airports use an outer marker beacon or even an NDB. The controller may have instead requested the pilot to report the FAF (instead of actually saying "outer marker"). Some use only a VOR, DME point, or even a cross bearing such as depicted in figure 386 for the Mirty intersection. A cross bearing from the BZM VOR is used to establish the Mirty intersection.

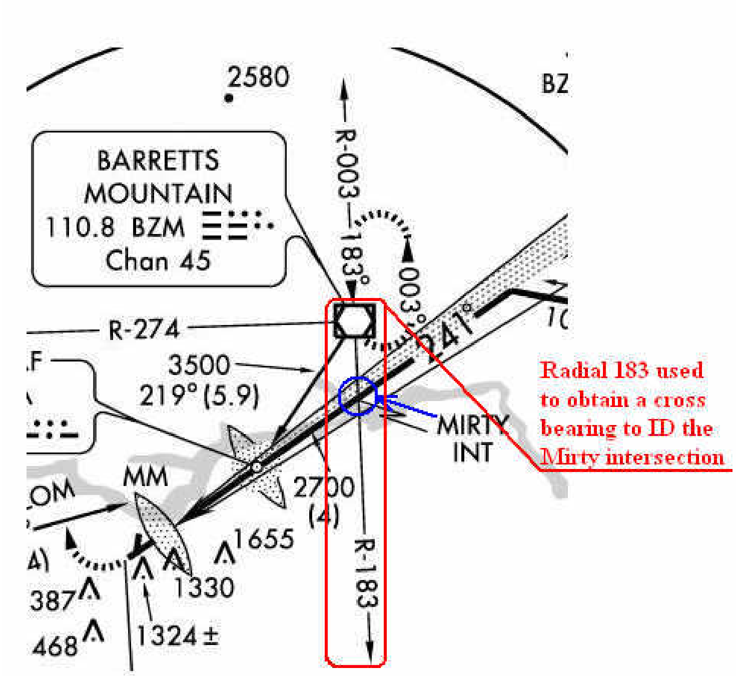


Figure 386 - Mirty intersection identified by the BZM VOR radial 183.

The controller using FS Navigator can measure exactly the distance provided by the charts to get an idea of when it is best to make the final landing clearance but typically is given after just passing the FAF. Controllers should never give the clearance too early as the multiplayer environment can change suddenly. They should wait until the pilot has reached the outer marker for final landing clearance.

Pilot – The pilot acknowledges the final landing clearance provided by the tower controller and continues the approach down the glide slope to the DH where the pilot *must* have positive visual contact with the runway surface to continue *below* the DH (the MAP) and complete the landing. If the pilot does *not* make positive visual contact with the runway a missed approach is executed immediately (read the missed approach procedure *before* starting the approach, stay ahead of the game).

Note, some of the more complex aircraft have TO/GA (takeoff and go-around) buttons that help the pilot achieve takeoff thrust as the pilot keeps the wings level, takes care of retracting the gear and flaps such as shown in figure 387. There are other buttons for climb power (CL), cruise power (CR), takeoff (TO-1).

Figure 387 - Power management buttons on complex modeled aircraft.

Again, an important reminder here, if you notice the MM point in the approach profile view in figure 380, it is co-located with the MAP (or DH). If you can *not* see the runway and you see or hear the middle marker beacon you need to be executing the missed approach applying full power with the aircraft nose coming up. When a positive rate of climb is indicated get the gear up. Remember, in this example you are only 200 feet AGL and that space disappears fast if you don't *arrest the* *descent.* Take care of raising the flaps a notch at that time to prevent an inadvertent stall (*remember you typically have full flaps at this point*). Many pilots forget to pull the flaps up a notch or two causing them to get into a stall condition with the aircraft (*bad news when you're low and slow!*).

Most missed approaches are straight ahead at least until you get the aircraft reconfigured (if you're on course you'll be over the runway area even though you can't see it), then you can get going on the missed approach procedures. *Never start a missed approach until reaching the MAP.* Don't forget to declare a missed approach with the tower controller. If you don't hear from the controller continue the published procedures on the chart to the holding point and then hold until making contact and receiving further instructions. If the tower controller responds (and they should <grin>) tell them your intentions, either to try the approach again or that you wish to proceed to your alternate airport. The controller will provide the necessary instructions and vectors as requested.

This chart provides much more information on it than what is required for the virtual pilot but can still be handy such as the type of lighting that can be expected at the runway threshold. Airports have different runway lighting schemes to aid the pilot in locating the runway threshold during landing, some are very elaborate. There may also be special light systems to help guide the pilot visually along a glide slope. Approach lighting and visual glide slope systems are indicated on the airport chart by an identifier. On our example approach chart runway 24 has a lighting configuration called MALSR (Medium Intensity Approach Lighting System with runway alignment indicator lights). The MALSR light configuration system is the same as the SSALR system shown here in figure 388.

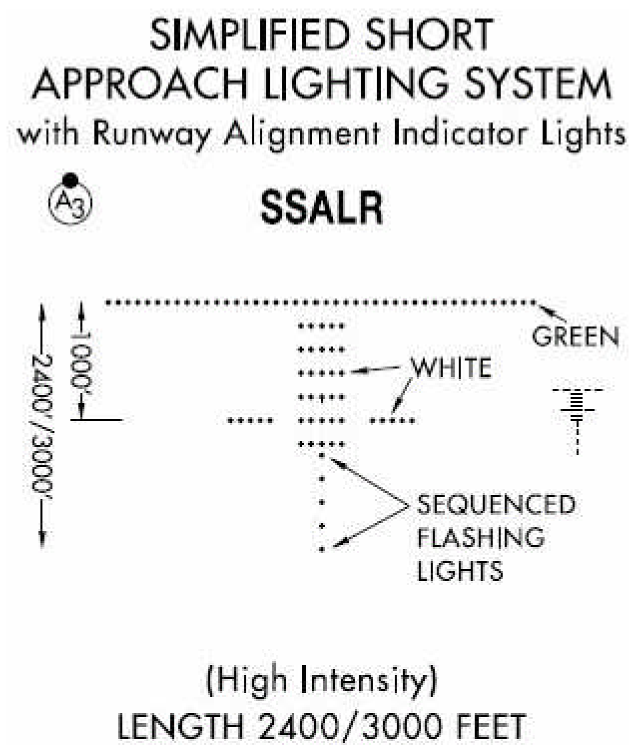


Figure 388 - The SSALR/MALSR light systems.

Look just to the left of the MISSED APPROACH procedures box at the top of the chart to see a small depiction of the lighting configuration as in figure 389 left. It is also depicted on the top down view as in figure 389 right. The small black dot on top of the A5 lighting identifier indicates flashing lights installed with the approach lighting system. If the approach lighting identifier (A5) is shown in negative symbology (all black background with white lettering as is our case here) this indicates the lighting can be controlled by the pilot via the cockpit radio in real-life (unfortunately this is not simulated). In the real-world it allows the pilot through a series of PTT presses on the COM radio to turn on and off specified runway lighting while airborne.

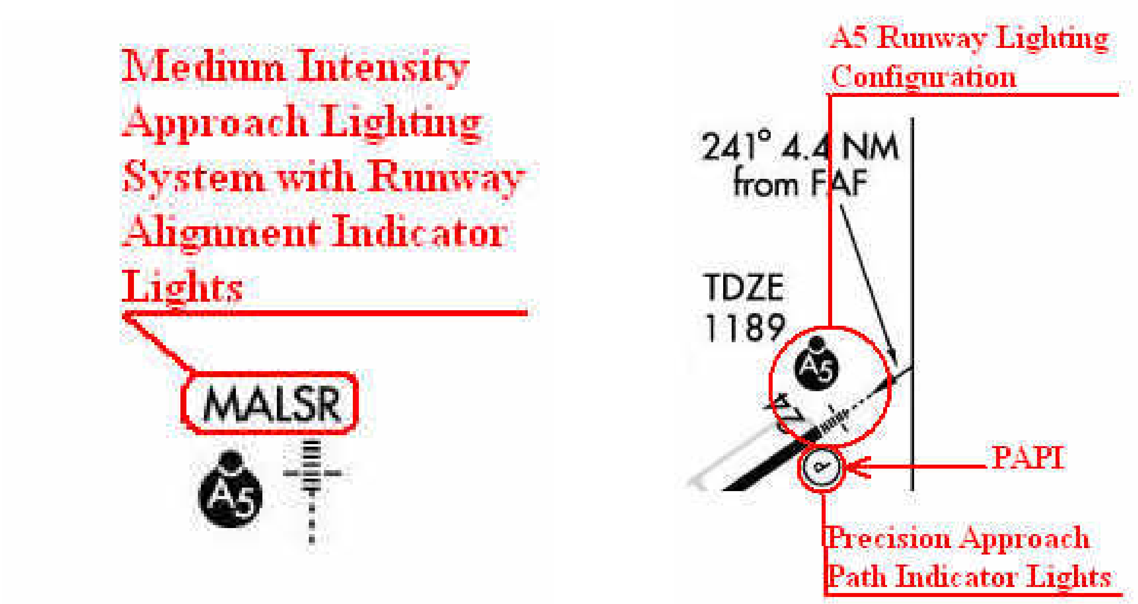


Figure 389 - Approach lighting type available to the pilot.

Also note the symbol in the top-down view (figure 389 right) just to the left of the threshold (a circled P). This indicates the approach has a PAPI (Precision Approach Path Indicator) light system.

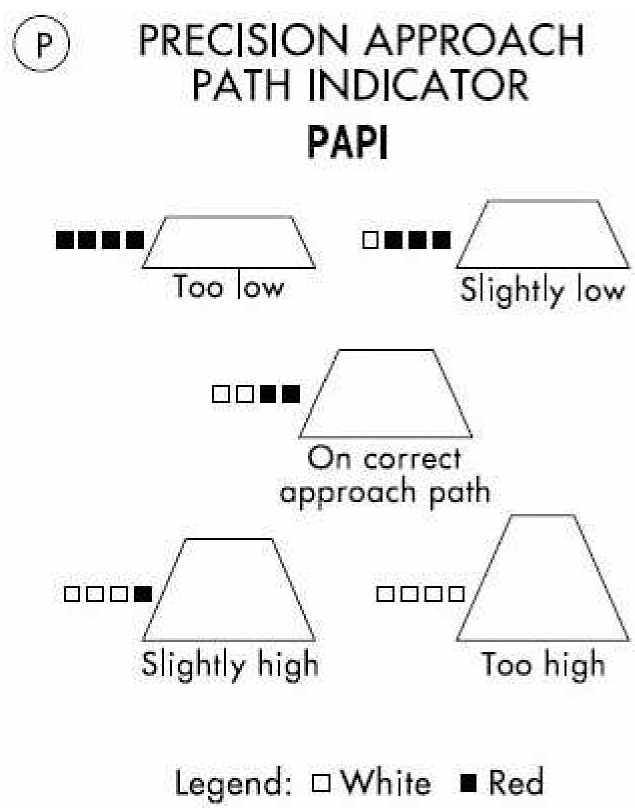


Figure 390 - PAPI glide slope indicator system.

PAPI lights are similar to VASI (Visual Approach Slope Indicator) light systems. Both provide a visual glide slope reference for the pilot to follow by interpreting the light indications, note that not all lighting systems are properly simulated (or displayed) within flight simulator such as a VASI being shown in the scenery where a PAPI light system should be.

Figure 391 is a screen shot of the final approach to runway 24 that shows the above lighting configuration.

Figure 391 - Approach lighting as seen from the cockpit during the landing.

The chart also provides the responsible ATC center for the ILS approach into this airport, in this case it is the ARTCC in Atlanta.

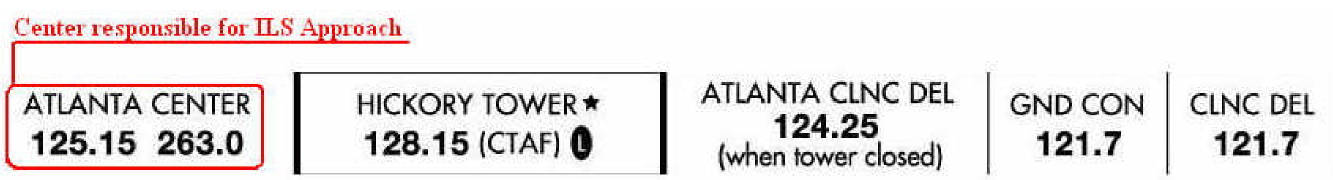


Figure 392 - ARTCC responsible for approaches to KHKY.

Another box in the upper left to the right of the approach course heading provides at a glance the runway length, and altitude of the touchdown zone and airport elevation in MSL.

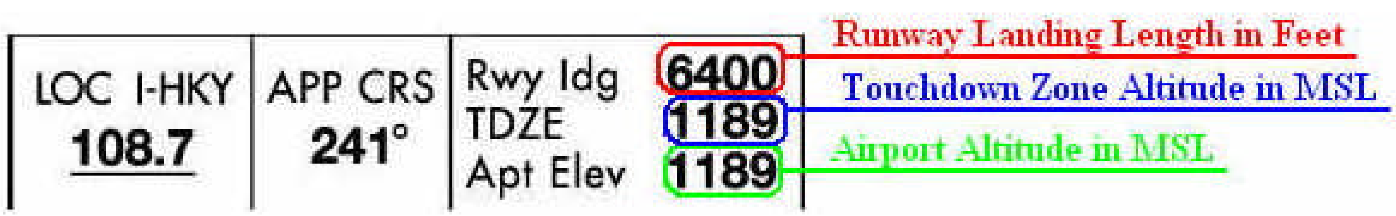


Figure 393 - Runway landing length, Touchdown zone elevation, and airport elevation information.

All this information about the ILS approach and associated airport can be very useful to pilot and controller in many ways. This may seem complex but actually with some practice it becomes easy to extract the information required. Don't forget most of what has been discussed about the approach happens in a short period of time. From the IAF the approach probably won't take longer than 5 to 15 minutes depending on aircraft type and winds. So it pays to practice. The pilot needs to execute controller instructions in a timely manner or things may get problematic very quickly. It requires familiarity with the aircraft to be flown (ever wonder why pilots are required to have an "aircraft type" certification?)

GROUND CONTROLLED APPROACH (GCA)

Toward the end of chapter 1 I discussed something called PAR (Precision Approach Radar). There is no provision for such a radar built into flight simulator, so a developer named Michael Oxner built one for us and made it available as freeware on his site at http://bathursted.ccnb.nb.ca/vatcan/fir/vPAR/.

There are primarily three programs available, one used by the pilot (the vPAR Transponder), then a choice of two others for the controller (vPAR QuadRadar or vPAR QuadRadar Analog). The pilot installs the vPAR Transponder onto his/her computer and the controller installs either the vPAR Quad or Quad Analog on his/her computer. The vPAR QuadRadar can be used either in a standard logarithmic mode or a new linear mode (reference the vPAR documentation on the differences). Once installed if they wish to conduct a GCA (Ground Controlled Approach) they link the two together by the pilot's and controller's computer IP addresses (similar to connecting to FSHost or TeamSpeak. This allows the flight simulator to send information via the vPAR Transponder (a client-side program) to the host program which in this case is installed on a controller's personal computer. It would be nice if someday an ATC program were built to do all these together to eliminate having to run so many individual programs, maybe someday (HINT! HINT! <grin>).

So if any controller is going to be the GCA controller they must have one of the vPAR QuadRadars installed and the pilot must connect with that controllers program. The difference between the vPAR QuadRadar and the vPAR QuadRadar Analog is the type of scope presented for use by the controller (I personally like the newer "digital" version, the vPAR QuadRadar shown in figures 395 and 396). The analog version is shown in figure 394.

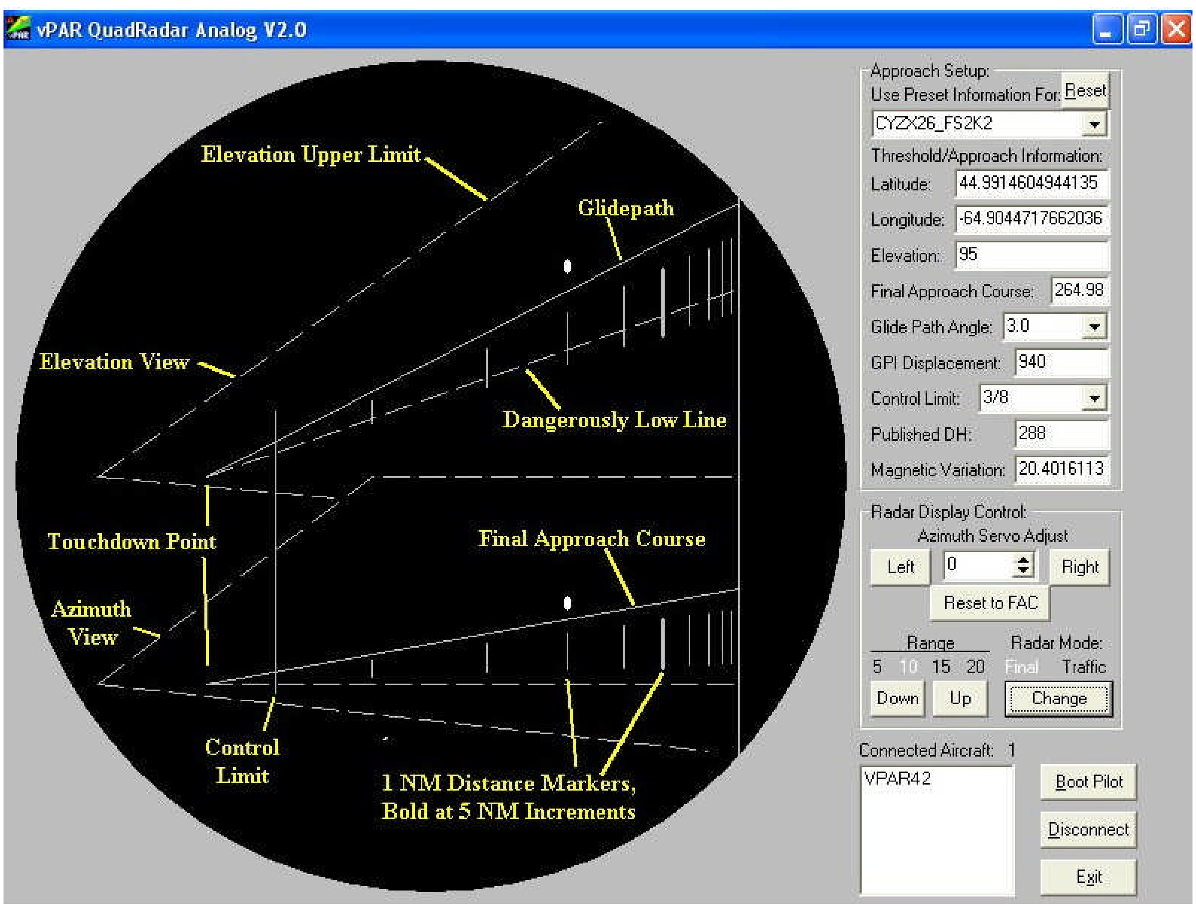


Figure 394 - vPAR QuadRadar Analog scope.

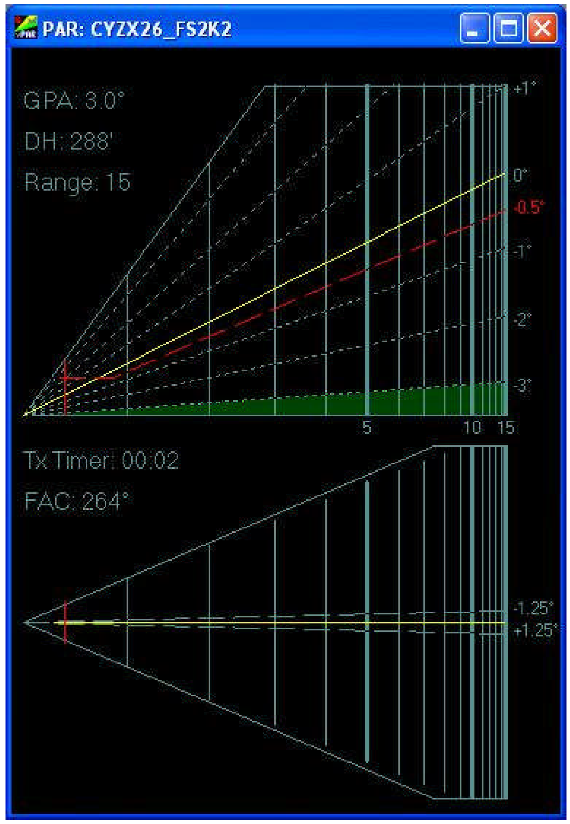


Figure 395 - The vPAR QuadRadar scope standard logarithmic mode.

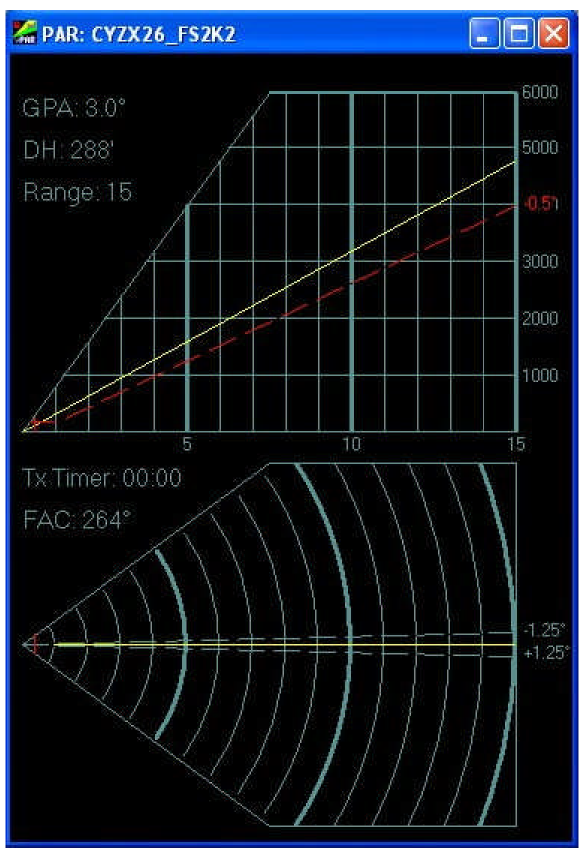


Figure 396 - vPAR QuadRadar scope linear mode.

So just what is a ground controlled approach? To answer your question think of it like this, during an ILS approach the pilot uses the NAV1 receiver to pickup signals transmitted from the ground and translate those signals into visual indications via either the VOR1 gauge or maybe an RMI gauge so as to determine deviations from the approach path and glide slope (remember the gun scope cross hairs?). That is what the needles on the VOR1 or RMI gauge look like when the pilot is smack on the approach path and glide slope. The pilot does his own thing (no external help) to get the aircraft to the ground by correcting deviations displayed by either gauges.

Now what if the NAV1 receiver is busted (simulated of course <grin>) and the pilot simply doesn't have an ILS gauge to properly conduct an ILS (precision) approach? The pilot would most likely be limited to conducting a non-precision approach with higher minimums. Now let's not make it easy, let's say the pilot is in trouble and is running low on fuel and the weather isn't cooperating making a non-precision approach virtually (no pun intended <grin>) impossible. The pilot absolutely needs a precision approach. Well, if the airport has a precision approach radar (PAR) then a properly qualified controller could "talk" the pilot through a precision approach, that's correct, I said talk the pilot through the precision approach.

Using figure 396 as my example let's see how this is done. If you notice the scope in figure 396 is shown in two sections. The upper half represents the glide slope and the lower half represents the approach path. When the programs are linked properly (even while the pilot is linked to FSHost and TeamSpeak) the controller will see the pilot's aircraft as a blip on the two halves at the same time. There position will match in distance from the runway threshold (pretty much aligned vertically between the two scopes).

As the aircraft starts the GCA approach the controller instructs the pilot that no further responses are required (basically telling the pilot "don't respond to my transmissions unless I tell you too!") as the controller is about to do a lot of talking (sort of like an auctioneer <grin>). The controller will be rattling off the aircraft's position as it intercepts the glide slope and proceeds down it to the threshold by telling the pilot continuously of deviations from the approach path and glide slope. The pilot must react appropriately (it takes a bit of training and skill) but still it is much like conducting an ILS approach. If a pilot can use proper skills to stabilize the aircraft in the descent with a proper angle of attack, airspeed, and vertical descent rate, then the pilot will most likely be able to conduct a GCA approach without much problem.

The controller must be trained and proficient using the terminology and phraseology required for use during a GCA approach so as to efficiently guide the pilot to a safe landing. I include this type approach in my manual because they can be a blast to conduct. It is an ultimate challenge to see if you can get the pilot and aircraft on the ground safe and in one piece just as you would conducting an ILS approach. As always it takes practice.

Except for the technicalities of getting connected (and that is very easy once learned) there isn't a lot of cockpit know how other than the pilot being able to fly the aircraft in a stable descent by means of the typical cockpit instruments such as airspeed, vertical descent, altimeter, artificial horizon, and the directional gyro and lending an ear to the GCA controller.

Here is an example of the phraseology used during the approach. This first section typically occurs during the vectors-to-final.

Controller: N9COF this is your final controller how do you read this transmission?

Pilot: Loud and clear N9COF.

Controller: N9COF this will be vectors for the precision radar approach to runway 24, the glide slope angle on final is set at 3 degrees and the published decision height is 1389 feet.

Pilot: N9COF roger. Requesting a full stop landing.

Controller: N9COF roger, if no transmissions received for a period of 30 seconds while on traffic or 5 seconds while on final carry out the published missed approach and attempt to contact Hickory tower on 125.25.

The controller at this point provides vectors-to-final. As the aircraft is established on the final approach course the transmissions would proceed something as follows:

Controller: N9COF fly heading 260. You are now on final approach; do not acknowledge further transmissions unless requested by radar.

The controller will at this point issue instructions and position information at least every 5 seconds and preferably more often to make sure the pilot is kept abreast of where s/he is *and that s/he is still in communication with the controller*. In the following section of communications the pilot must react immediately to any deviations the controller indicates, but keep your control inputs small so as not to over correct. The controller will let you know if your corrections are working, *don't over react*. Realize that as you get closer to the runway the tolerance for error narrows so you need to be spot on as you get closer. If the controller sees things going wild then the controller will most likely be the first person to call for the missed approach, if so do as instructed! It is a common fact that if the approach is not going well early on that it will most likely be a bust (missed approach <grin>). Ground controlled approaches that start well have the best chance of success. So if your new at this make sure you start the approach farther out, say 20 miles at least. Give yourself time to stabilize the aircraft.

All transmissions from here are those of the controller:

…Well right of course correcting rapidly, fly heading 225.
…9 miles from touchdown, fly heading 230.
…Intercepting the course, fly heading 240.
…On course 8 miles from touchdown.
…Left of course, correcting slowly (or "nicely", or "rapidly").
…Left of course and paralleling.
…Drifting left of course, turn right heading 242.
…Well left of course, turn right heading 245.
…On course fly heading 242, 7 miles from touchdown, 2 miles to glide slope interception.
…Slightly left of course, standby for glide slope interception, wheels should be down.
…Intercepting glide slope, commence descent now, decision height 1389 feet.
…Initial rate of descent has you slightly below glide slope, adjust rate of descent.
…On course.
…Above glide slope, adjust rate of descent.
…Left of course, fly heading 244, 4 miles from touchdown.
…Back on glide slope, resume normal rate of descent, on course.
…Below glide slope adjust rate of descent, 3½ miles from touchdown, on course.
…3 miles from touchdown, dangerously below glide slope, level off your aircraft, acknowledge.

Pilot: N9COF roger. (The pilot basically flies the aircraft straight and level at this point. The aircraft will eventually fly back into the glide slope from underneath. DO NOT go any lower!)

Controller again:

…Back on glide slope, resume normal rate of descent, 2½ miles from touchdown.
…On course.
…On glide slope.
…2 miles from touchdown, tower clears N9COF to land runway 24, winds 330@10, check gear down and acknowledge.

Pilot: N9COF roger, gear down.

Controller again:

…½ mile from touchdown.
…passing through radar control limits.
…On course, slightly above glide slope.
…Approaching threshold, look ahead for landing, radar standing by. (At this point the pilot looks ahead to see the runway, if no runway is to be found go missed approach contacting the controller again, if the runway environment is in sight then continue the landing.)

As you can see the scenario gets pretty intense. The pilot watches his instruments like a hawk and the controller watches the PAR radar with the same intensity.

Michael Oxner makes one final comment about the cons to the vPAR program. It has to do with the age old problem of having different scenery loaded on the pilots and controllers personal computers like I discussed in chapter 1. Add-on sceneries can cause there to be a misalignment of the runway from that of what the controller is using (*the PAR approach path is established using the controller's scenery data*). The vPAR program allows the controller to setup a GCA approach (very accurately I might add) to any runway present in the controller's scenery but again if the pilot is using different scenery, then the controller may actually guide the pilot to where there is no runway. In some cases the misalignment may only be slight and the pilot may be able to take control of the approach visually without a problem by telling the controller "…runway in sight taking over manually". It is always best to participate in online activities using the default scenery provided by the flight simulator. Also don't forget that if you use different versions of flight simulator such as FS9 and FSX that the same problem can exist due to the differences in the scenery. So he stresses there is the potential for error, so stay alert and remain understanding if all doesn't work so smooth <grin>.

One other note, vPAR does come equipped with an airport area surveillance type scope including an airport (tower) top-down view scope. I use FS Navigator or ATC Radar Screen for all my vectors-to-final operations and airport operations just to keep things simple. Manuel's highly anticipated new version of ATC Radar Screen would be great if a GCA capability could be added to it (maybe you never know <grin>?).

NON-PRECISION INSTRUMENT APPROACHES

When I discussed precision approaches I mentioned that the key element that makes an approach a precision approach is the electronic glide slope. Without it the approach becomes a non-precision approach (lateral guidance only) leaving us without a means to descend on a predetermined slope we can "see" via the needles in our gauges. Without this guidance the pilot could descend to fast reaching the ground far before reaching the runway or not descend fast enough flying over and past the runway completely, so descents must be made in a different manner during non-precision approaches, by "stepping down" to lower altitudes after reaching predetermined points along an approach path to finally reach the lowest but safest altitude to visually acquire the runway. This altitude tends to be much higher than the DH provided during a precision approach (which normally is at or below 200 feet AGL approximately ½ mile or less from the runway threshold). Typically the visibility required for non-precision approaches is higher because the pilot needs to see farther ahead (using forward visibility) due to the increased altitude to acquire the runway visually and start a descent by leaving the published MDA. The pilot must be able to maintain visual contact with the runway throughout the descent after leaving the MDA until touching down else a missed approach must be executed (and trust me, it is tempting not to do that <grin>). The pilot should never descend below the MDA without acquiring the runway visually and even then the approach still may not be appropriate depending on how close the aircraft is to the runway threshold because the aircraft must be able to approach the runway without making unusual maneuvers or descents. So let's take a look at some of the various non-precision approaches. We'll discuss the Localizer front course approach (abbreviated as LOC), the Localizer back course approach (abbreviated as BC), the VOR approach, the NDB approach, and the GPS approach.

LOCALIZER FRONT COURSE APPROACH (LOC)

This approach is identical to the ILS approach when it comes to the lateral navigation portion of the approach. Lateral navigation as you know now is the path to the runway. The same localizer you use for the ILS approach is what will be used for a localizer front course approach. Since the glide slope is not present though we will need to pay close attention to the "step down" altitudes indicated on the published approach procedure. Presented on the approach chart will be points identified by some electronic means, such as a cross bearing from a navigational transmitter, distance measuring equipment, GPS fix, or even by marker beacons to tell the pilot when it is safe to descend to a predetermined altitude along the approach path eventually reaching the minimum descent altitude (MDA) that the pilot must maintain until visually acquiring the runway threshold.

For this example I'm going to use the LOC RWY 16 approach at Asheville NC (KAVL) using figure 397. If you notice the chart is used for the ILS and LOC approach. The older chart was actually labeled ILS RWY 16 but more recently they have labeled it as a LOC approach also (the localizer portion of the approach has always been there anyway, so why not).

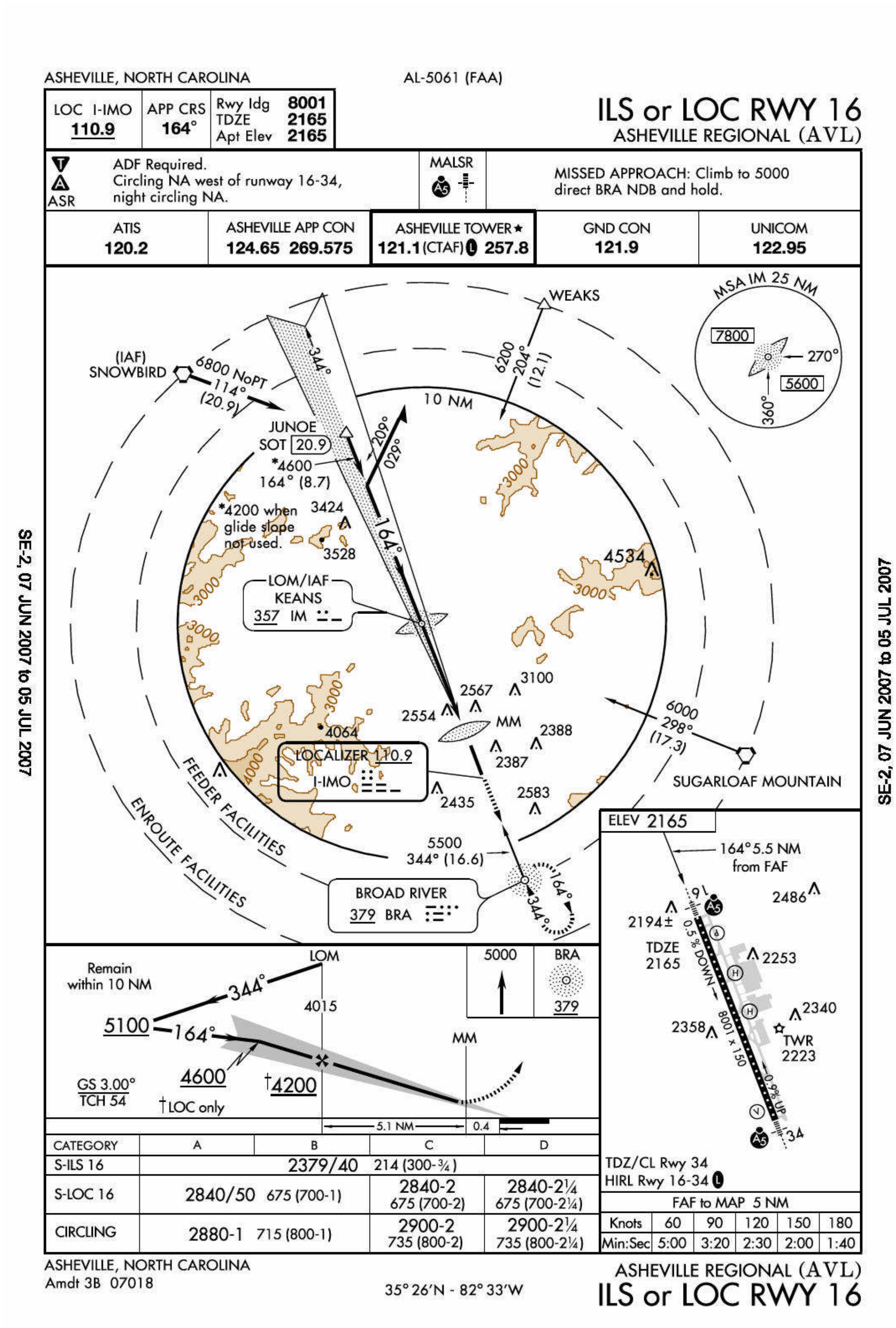


Figure 397 - ILS/LOC RWY 16 at KAVL

Now when you use your gauge to track the localizer to the runway if the course deviation indicator (CDI) needle on the gauge goes off to the right then you know this means you must turn the aircraft to the right to get back on the proper approach path. If the needle goes off to the left then you must turn the aircraft to the left to again get back on the proper approach course. Take a look at figures 398 and 399 of a localizer front course approach using an RMI gauge. I kept the weather clear so you could see the aircraft position in relation to the gauge indication.

Figure 398 - Localizer approach using an RMI (shown left of course).

Figure 399 - Localizer approach using an RMI (shown right of course).

The RMI gauge gives a proper indication as long as the OBS setting is set for the proper inbound heading. If you were to reverse the OBS setting (set the heading 180° the opposite) then the deviation indicator (CDI) in the RMI will be on the opposite side. Take a look at figures 400 and 401.

Figure 400 - Localizer approach using an RMI (shown left of course) with the OBS setting 180° opposite.

Figure 401 - Localizer approach using an RMI (shown right of course) with the OBS setting 180° opposite.

In figures 400 and 401 if you turn the aircraft in the direction of the CDI needle you will actually fly farther away from the proper centerline course (NOT GOOD MAYNARD! <grin>). This is why it is important to set the OBS setting properly as shown in figures 398 and 399.

Now what if you are using the default VOR gauges during a localizer front course (such as in the Cessna 172 or 182)? Well, let's take a look at that.

Figure 402 - Localizer approach using the default VOR gauges (shown left of course).

Figure 403 - Localizer approach using the default VOR gauges (shown right of course).

In figures 402 and 403 the VOR1 gauge OBS setting is on the proper approach heading and notice the opposite OBS setting on the VOR2 gauge but the CDI needles are both indicating the correct turn to get back on the approach centerline when either left or right of course. In this case setting the OBS incorrectly has no affect on the displayed indication as it did when using the RMI gauge. The primary reason for making the proper OBS setting here is just to remind the pilot of the correct inbound heading.

The VOR gauge characteristic noted above is different than when using the VOR gauges to track TO/FROM a VOR transmitter as discussed back in chapter 3 "Navigation by VOR". In that situation, depending on the location of the aircraft in reference to the location of the VOR transmitter and also considering the OBS setting, the CDI needle will center itself twice when rotating the OBS setting and "flipping" the TO/FROM flag.

In the case of tracking a localizer the TO/FROM flag always indicates TO and the CDI centers only while on the localizer centerline. The rotation of the OBS setting will not "flip" the TO/FROM flag but may reverse the displayed indication such as when using the RMI gauge. So bottom line always set the OBS setting to the inbound heading during the localizer approach.

These same characteristics apply while using the localizer during an ILS approach; again the bottom line is to set the OBS setting to the proper inbound heading as shown on the approach chart.

In this case, during a localizer only approach where the glide slope isn't available the pilot must now use a different set of minimums, so instead of using the S-ILS 16 line for the minimums (as in the case of an ILS approach) the line labeled S-LOC 16 is the correct choice to reference the minimums. If you would happen to be flying in a Cessna 172 (category A) then your MDA will be 2840 feet MSL. The 50 in this case is an RVR value x100, so the RVR value is 5000 feet.

Now I discussed RVR several times over and you're probably asking yourself "…but how do I use that since it isn't simulated?" Good question! Well there is a conversion we can use for typical RVR values per the Legends and General Information provided for IAP charts and figure 404 shows us what is prescribed concerning this.

As the note states if the RVR value given on the approach chart (as in figure 397) falls in-between those listed on the chart in figure 404 the pilot must use the next higher value and is not allowed to "calculate" an in-between value for the statue miles. Since our straight in approach using the localizer prescribes an RVR value of 5000 feet the conversion to statue miles is 1 statue mile. So if the weather provided by FSHost is at least 1 statue mile or better than conducting this LOC approach is okay (legal <grin>).

Comparable Values of RVR and Visibility

The following table shall be used for converting RVR to ground or flight visibility. For converting RVR values that fall between listed values, use the next higher RVR value; do not interpolate. For example, when converting 1800 RVR, use 2400 RVR with the resultant visibility of 1/2 mile.

RVR	Visibility (statute miles)	RVR (feet)	Visibility (statute miles)
1600	¼	4500	⅞
2400	½	5000	1
3200	⅝	6000	1¼
4000	¾		

Figure 404 - Conversion of RVR values.

I'm going to start this approach from the SNOWBIRD VOR which is an IAF for the approach (reference figure 405).

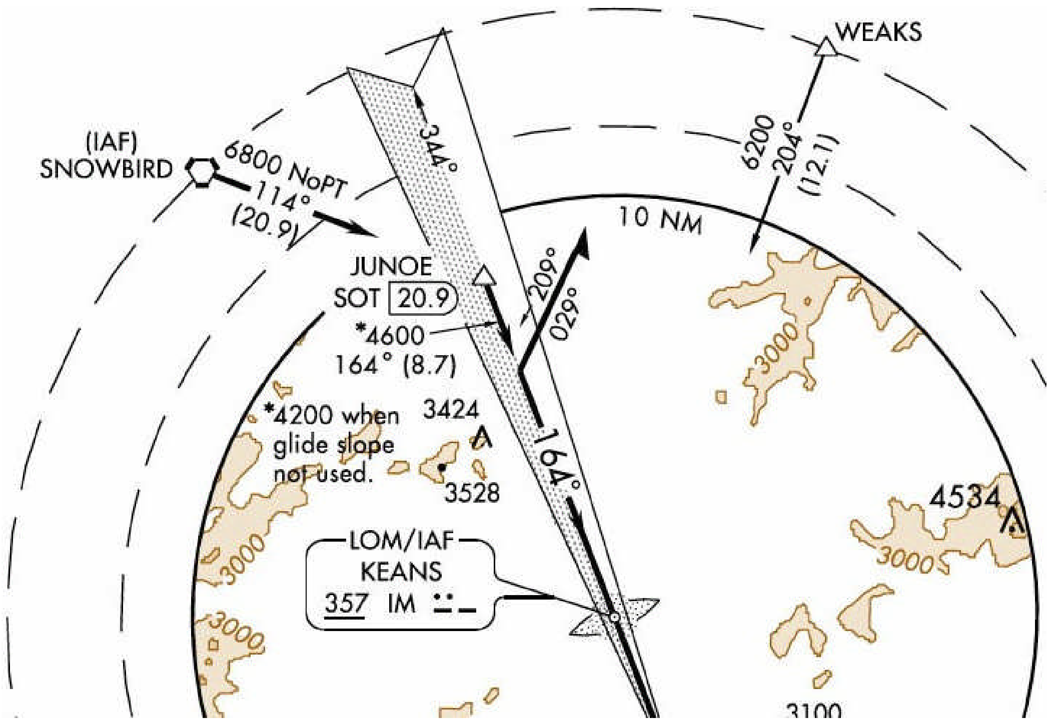


Figure 405 - The initial approach to RWY 16 at KAVL.

In this case the approach can be conducted from SNOWBIRD without completing the procedure turn (indicated by the NoPT which means "No Procedure Turn"). The pilot can descend to 6800 feet MSL over SNOWBIRD on the way to JUNOE on a heading of 114°. The distance from SNOWBIRD to JUNOE is 20.9nm. Once reaching JUNOE the pilot turns to a heading of 164° (don't forget to set the OBS setting on the navigation gauge being used to read 164°).

Here there is a special note. The pilot, if conducting the ILS (with a glide slope present) would be required to maintain 4600 feet MSL until intercepting the glide slope (in this case the proper glide slope intercept altitude). This is one of those rather rare occasions where the glide slope is not necessarily intercepted right at the FAF but slightly before the FAF. As always the pilot should intercept a glide slope at the published altitude (indicated with the lightning bolt) as in figure 406.

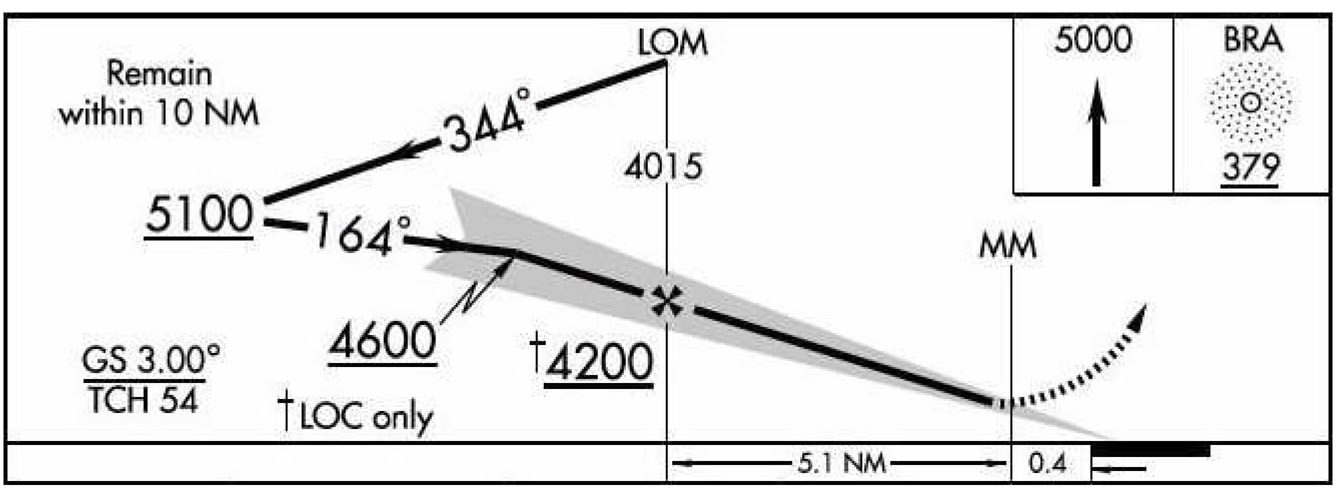
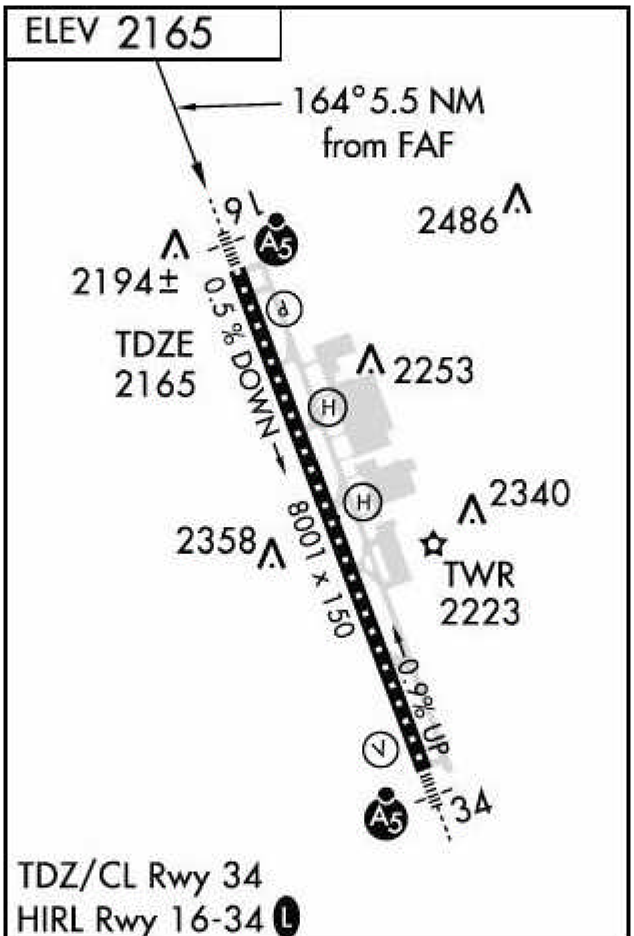


Figure 406 - KAVL LOC RWY 16 profile view.

Since our example here is about a localizer only approach the pilot is actually allowed to descend to 4200 feet MSL. This is indicated in figure 405 and 406. You may ask "…but why can I not intercept the glide slope at this same altitude?" and I will remind you it is primarily to avoid intercepting false glide slopes, you must always use the altitude published. Once the pilot reaches the FAF the aircraft can descend to 2840 feet MSL which the pilot maintains until reaching the MAP or acquiring the runway threshold visually to continue the descent to landing.

Someone might be wondering "…how do I tell where the MAP is?", again that is a good question. In figure 406 you will notice that from the FAF to the runway is 5.5nm. Also in figure 407 there is a note near the top next to the ELEV 2165 reference that points at the approach path that states "164° 5.5nm from FAF". Now look at the bottom of figure 407 just above the knots where it states the distance from the FAF to the MAP is 5nm, looking at the profile view in figure 406 that puts the MAP just before the middle marker (MM) because the distance from the FAF to the MM is 5.1nm.



FAF to MAP 5 NM					
Knots	60	90	120	150	180
Min:Sec	5:00	3:20	2:30	2:00	1:40

Figure 407 - Distance from the FAF fix to the MAP.

So there are two ways to tell where the MAP is and when the missed approach must be executed. The primary way is by using the chronograph timer in the aircraft on this approach. I believe I mentioned that sometime back and now you know that it isn't just there to admire, it is used to time your approaches. The pilot should start the chronograph when on top of the FAF. If I'm flying in a Cessna and maintaining an indicated airspeed of 90 knots then per the small table at the bottom of figure 407 it will take 3 minutes and 20 seconds to reach the MAP. This requires keeping your airspeed constantly on 90 knots (speeding up or slowing down will throw this calculation off). Fly with precision (that is the challenge!). If you're good at mathematics in your head (and I'm not <grin>) you can calculate the intermediate speed and associated time to the MAP if required. The pilot could calculate the time over the MAP at an IAS of 100 or 110 knots for instance. Fortunately I happen to own a "time" calculator (very handy indeed <grin>!) and have calculated the answers for you here. First I found the number of seconds after subtracting 3:20 from 2:30 to get 50 seconds. I want to calculate for the proper time over the MAP at the two speeds I talked about, 100 and 110 knots. That evenly divides the speed between 90 and 120 knots into three sections (90, 100, 110, and 120) 90 to 100 the first, 100 to 110 the second, and 110 to 120 the third. So if I divide 50 seconds by 3 I get 16 seconds point 40. Now subtract this from 3:20 gives us 3:03.20 (3 minutes and 3 seconds will work) at 100 knots. If we subtract 16 seconds point 40 from this new time we get 2:46.40 (more or less 2 minutes and 47 seconds) at 110 knots. You can use this same method for the other speeds if required. Why would you need to, well it depends on your aircraft specifications and approach speeds. You may be able to maintain one of the printed speeds (and most of the time you can) but sometimes you may need to adjust your speed such in the case of strong winds in which case you need to break out the thinking cap <grin>.

So what is the secondary method? In this case it is simple, if you hear via the marker (MKR) audio or see the AMBER light for the middle marker (MM) then you are already past the MAP (which means you are executing the missed approach right?). The middle marker is a great aid in identifying the MAP here but do not rely on it completely (in many approaches the timed method is the ***required*** procedure). Always use the chronograph to time your approach when available. It is a good way to see if you held your speed at a constant rate because the marker audio/light should be heard and seen when the time is up. Monitoring the GPS map is another great way to supplement your awareness of various points during any approach. Regardless, when the time runs out that is the MAP and the time to start executing the missed approach. Remember; *never execute the missed approach until you reach the MAP*.

The missed approach procedure in this approach is fairly straight forward, climb straight ahead to 5000 feet MSL and hold at the Broad River (BRA) NDB in lieu of instructions provided by a controller.

I discussed in the previous sections about acquiring the runway visually before legally being able to depart the MDA and continue the descent to the runway. I discussed the problem of the descent angle and visibility during the approach also. If you as the pilot can acquire and maintain sight of the runway far enough from it to allow a safe angle of descent then by all means depart the MDA and continue your landing approach, but if you are flying along and don't see the runway until the last second, then most likely you would be required to "dive bomb" the runway and that is not going to work; remember, the MAP is right at the end of the runway and if you are at the MDA when you reach the MAP you are probably much to high to make a safe and normal approach. In this case here you will be approximately 675 feet above ground level (AGL) when crossing the MAP, to high for a normal and safe approach.

Also notice in figure 407 the various towers in the airport area. If you can't see the runway you most likely can not see any obstacles, so do not depart the MDA unless you can make a safe approach via visual acquisition.

If the full procedure were to be conducted for this approach (I'm talking about completing the procedure turn as part of the approach) then the IAF would be the localizer outer marker (LOM) KEANS as depicted in figure 405. This procedure turn is conducted in the same manner as the procedure turn described in the section about the ILS approach. Once you learn how to conduct a procedure turn they are all basically the same (mind any special notes that pop up on occasion).

As with the ILS approach you may receive vectors-to-final by an online controller. Once you receive your *final clearance to conduct the approach you are responsible to follow the published procedures in the manner as described above when starting the approach at SNOWBIRD*. Remember, you the pilot once cleared by the controller are responsible to properly complete the approach once cleared to do so. Until you receive that clearance you must follow the controllers issued instructions.

LOCALIZER BACK COURSE APPROACH (BC)

The localizer back course approach is a unique approach. If there ever was an approach to confuse the simulator pilot this is one of them. The reason for this is technical, the localizer signal (very similar to the radials emitted by a VOR transmitter) interpreted by your aircraft instruments get reversed (or in other words the "sensing" of the localizer signal is reversed). We'll discuss this a bit more in just a minute but first let me describe this approach.

In the previous sections I explained that the ILS (and even the localizer front course just discussed for that matter) has a localizer antenna array located at the far end of the runway opposite that end which the aircraft lands on as seen here in figure 408.

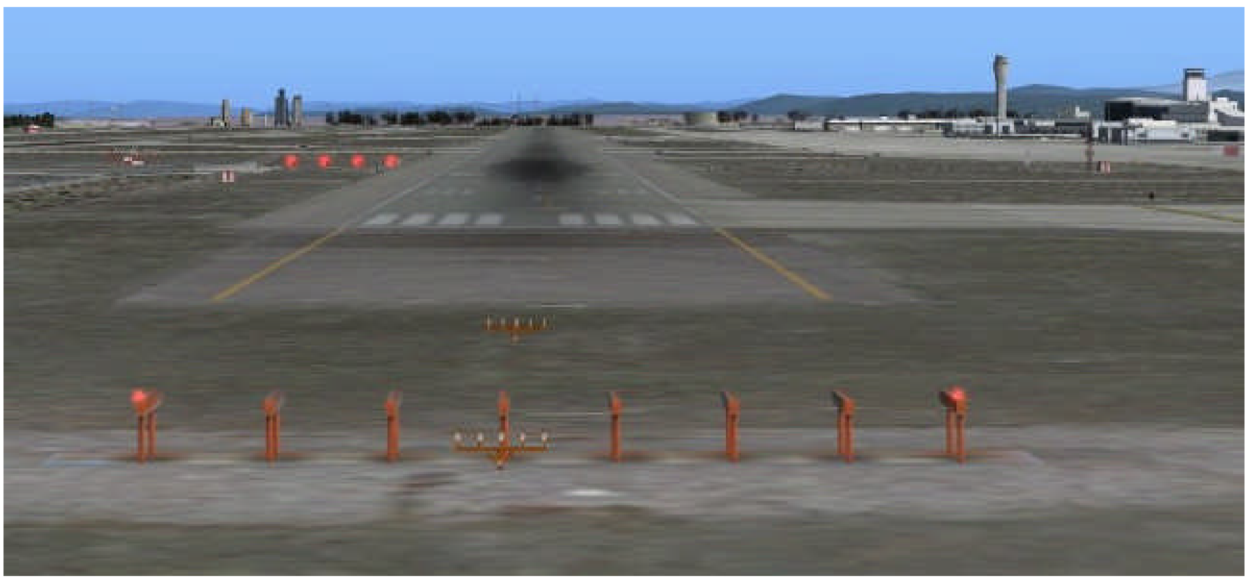


Figure 408 - Localizer antenna array.

For example, reference figure 409, if you are landing on an east/west runway (09/27) in a west direction (so this means you are landing on runway 27) then the localizer antenna array for the runway 27 localizer approach is located on the opposite end of the runway (on the runway 09 side). The front course when combined with a glide slope makes an ILS. Without the glide slope it is just a localizer (LOC) approach. The back course for this localizer is on the runway 09 side where the antenna array itself is located.

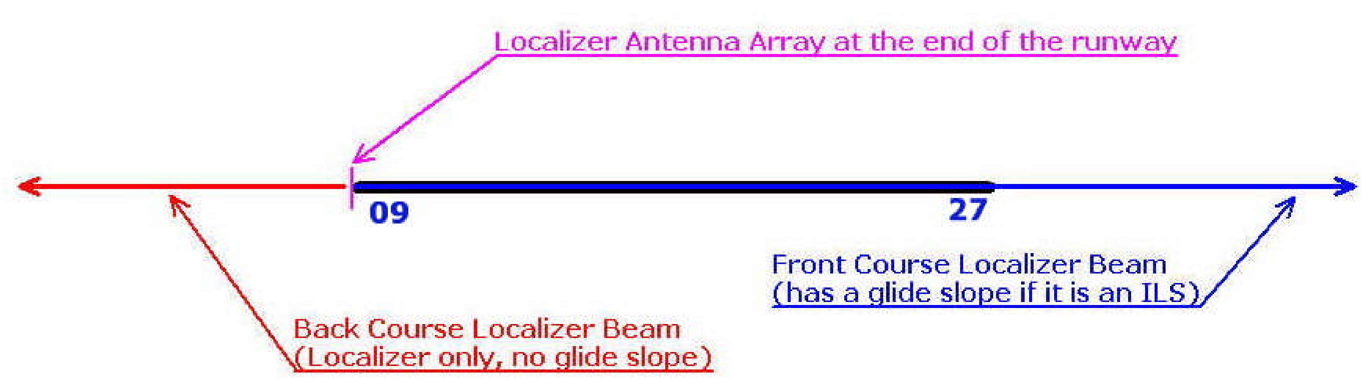


Figure 409 - The localizer front and back courses (top-down view).

When looking at an instrument approach chart (NACO chart) the localizer is depicted as follows in figure 410. The same note that applies to the localizer front course (right side shading) applies to an ILS because an ILS is always on the front side course.

Figure 410 - The localizer (or back course) feather as seen on an approach chart.

If a controller is looking at FS Navigator the back course feather is depicted differently than the front course feather as seen in figure 411.

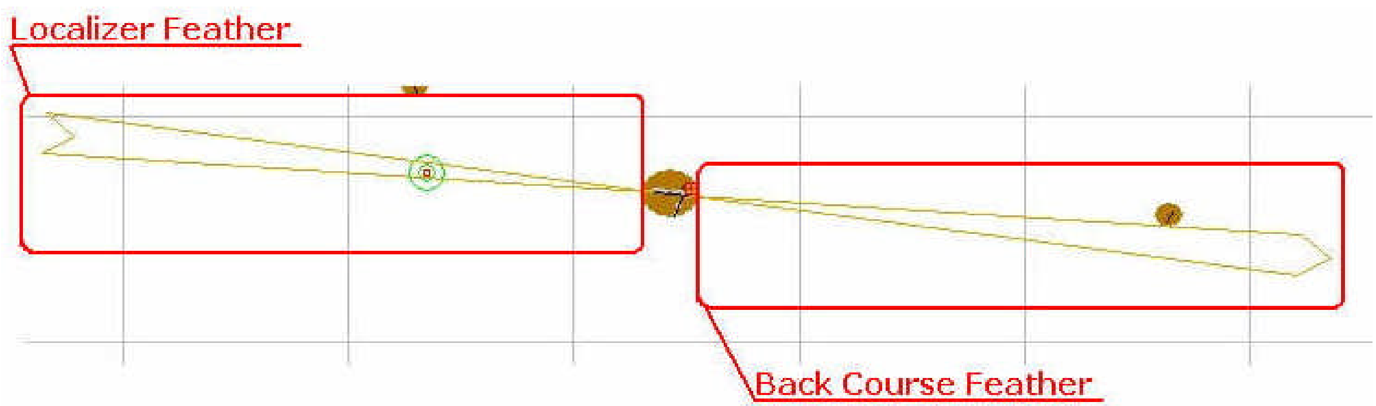


Figure 411 - Localizer feathers as depicted on the Fs Navigator map.

Now we come back to our discussion about using the navigation gauges to track a localizer back course. This is where pilots get into all sorts of trouble. So let's get this problem straightened out once and for all.

Remember our discussion above about the localizer front course and how to use the gauges and how the CDI needle reacts to the localizer signal. Well, take a look at figures 412 and 413.

Figure 412 - Localizer back course approach using the RMI gauge (shown left of course).

Figure 413 – Localizer back course approach using the RMI gauge (shown right of course).

Notice that the CDI needle in figure 412, 413, 414, and 415 are reversed! Compare these two figures with figures 398 and 399. If you turn the aircraft in the direction of the needle in figures 412 through 415 the aircraft will travel farther away from the localizer centerline. This is "reverse sensing". Inexperienced pilots don't know about this characteristic and typically do as they always do (follow the CDI indication as they would a front course) and then wonder why the approach went bad. The same is true when using the VOR gauges for navigation and not setting the OBS correctly.

Figure 414 - Localizer back course approach using the VOR1 and VOR2 gauges (shown right of course).

Figure 415 - Localizer back course approach using the VOR1 and VOR2 gauges (shown right of course).

Notice in figures 414 and 415 only (non RMI gauges) that the CDI needles (again with no regard as to the OBS setting) will show reverse sensing along the back course. Also notice that the TO/FROM flags always show a TO indication (the same as on the localizer front course).

The pilot in this case MUST fly opposite the CDI deviation indications. So if flying along the back course and looking at the VOR1 gauge in figure 414 the pilot must turn the aircraft right (the opposite of the indication) to get back on the localizer centerline. If flying along the back course and looking at the VOR1 gauge in figure 415 the pilot must turn the aircraft left (again the opposite of the indication) to get back on the localizer centerline.

Of course this is awkward to follow but don't fret because someone thought about that and hence the REV (or BC) button on the autopilot. REV stands for "reverse" such as in "reverse" sensing. BC stands for back course. The REV Button is found on the autopilot in the default Cessna's. The BC button can be found on the default B737 and larger aircraft. Basically this button reverses the reversed signal (okay, your pulling your hair out I understand <grin>). But really, the button fixes the signal so the autopilot can properly track the back course localizer signal just like tracking the front course localizer signal. Even when the CDI needles are "reversed" the autopilot will compensate for this.

So if you conduct a localizer back course approach and use the autopilot to help you properly track inbound on the approach remember to press the REV or BC button instead of the APR button (remember the APR button is used for the localizer front course or ILS approach only). Be sure to always get this correct, on any localizer front course use the appropriate button, either APR, VOR LOC, NAV LOC, or other label the autopilot is modeled to use the localizer front course with. The same goes for using the autopilot during a localizer back course approach. The button may be labeled BCRS, LOC BC, or NAV BC. This ensures the autopilot will track the localizer properly!

Now you're wondering "…but what if I'm flying the airplane by hand, not using the autopilot?" Well, in the case of a localizer back course you'll have to remember to fly opposite the CDI indications. There is one exception to this. If you happen to be using an RMI gauge as in the above examples then you can cheat the system and reverse the OBS setting (in other words point the OBS course arrow to the bottom of the gauge) which effectively "flips" the CDI indication (reference figure 416).

Figure 416 - Localizer back course approach using the RMI reversed (shown left of course).

In figure 416 if you turn the aircraft right (as the CDI needle indicates) you'll return to the localizer centerline. Notice the yellow OBS arrow pointing to the opposite course heading at the bottom of the gauge.

Figure 417 - Localizer back course approach using the RMI reversed (shown right of course).

The same is true in figure 417 if right of course. Turning the aircraft left will bring the aircraft back to the centerline. Again the yellow OBS arrow is adjusted to point at the opposite approach course heading.

This cheat can be done on the RMI gauge due to the mechanical design of the gauge allowing the entire CDI display to be spun around. This is not possible on the default VOR1 or VOR2 gauges in the Cessna because the CDI needles can not be spun around (they're mechanically fixed).

Localizer back course approaches are as easy as the front course once you understand the nature of how the localizer signal works. The main thing is to check and double check your settings because it is easy to get confused. Always remember this during any approach especially this one, if during an approach it doesn't seem like it is going correct, then chances are it is going wrong. Your instinct is like fear itself, sometimes it can keep you alive; trust not only your instruments but your instincts also. If in doubt go missed approach, and get in a safe holding pattern to figure out what is wrong, then try it again.

VARIABLE OMNI-RANGE APPRAOCH (VOR)

The variable omni-range approach is a reliable and an easily tracked approach. Using similar concepts discussed in the localizer approach I'll describe here using yet another example how to conduct the VOR approach.

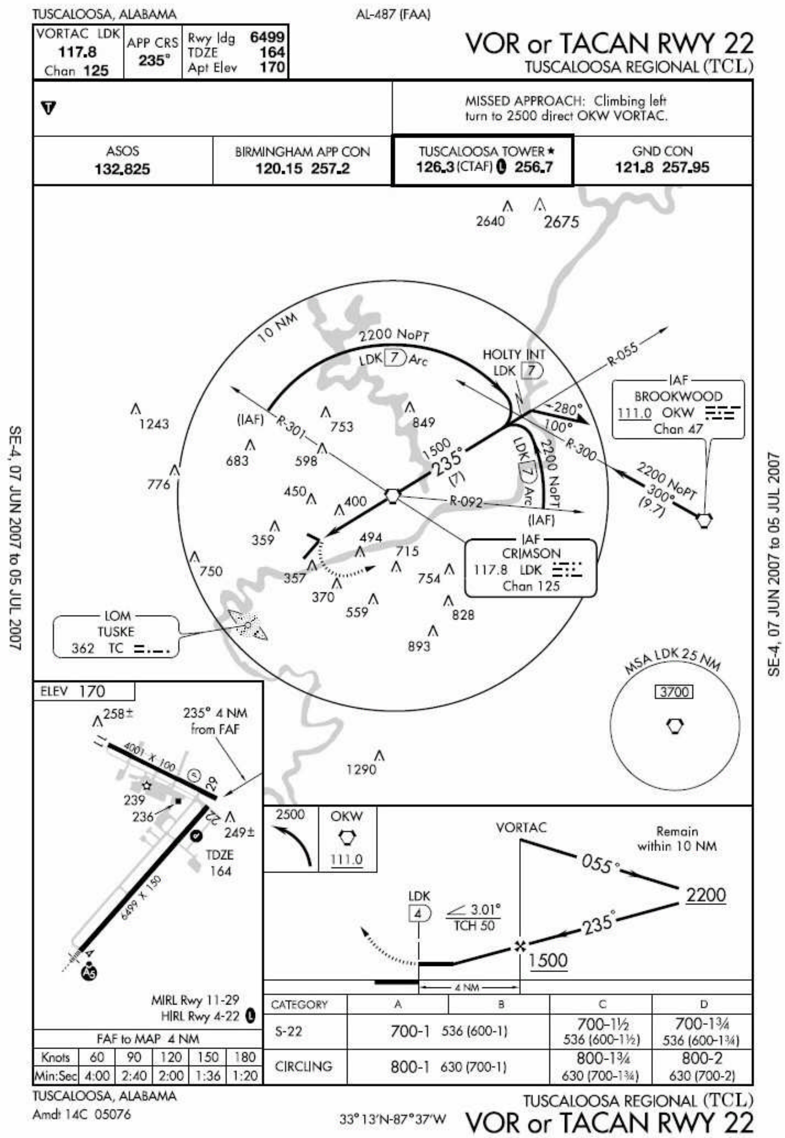


Figure 418 - The VOR approach RWY 22 at KTCL.

I choose this Tuscaloosa AL VOR approach because of the varied possibilities it has. A pilot can conduct a full approach via a procedure turn, DME Arc, or even with no procedure turn by way of the Brookwood (OKW) VOR. Another reason was because this approach is offset from the runway centerline. Not all approaches are designed smack dab on the runway centerline. This is indicated in the box in the lower left corner of the chart (top-down view of the airport obstructions) as seen in figure 419 left circled in red and also in the primary top-down approach view as seen in figure 419 right circled in red.

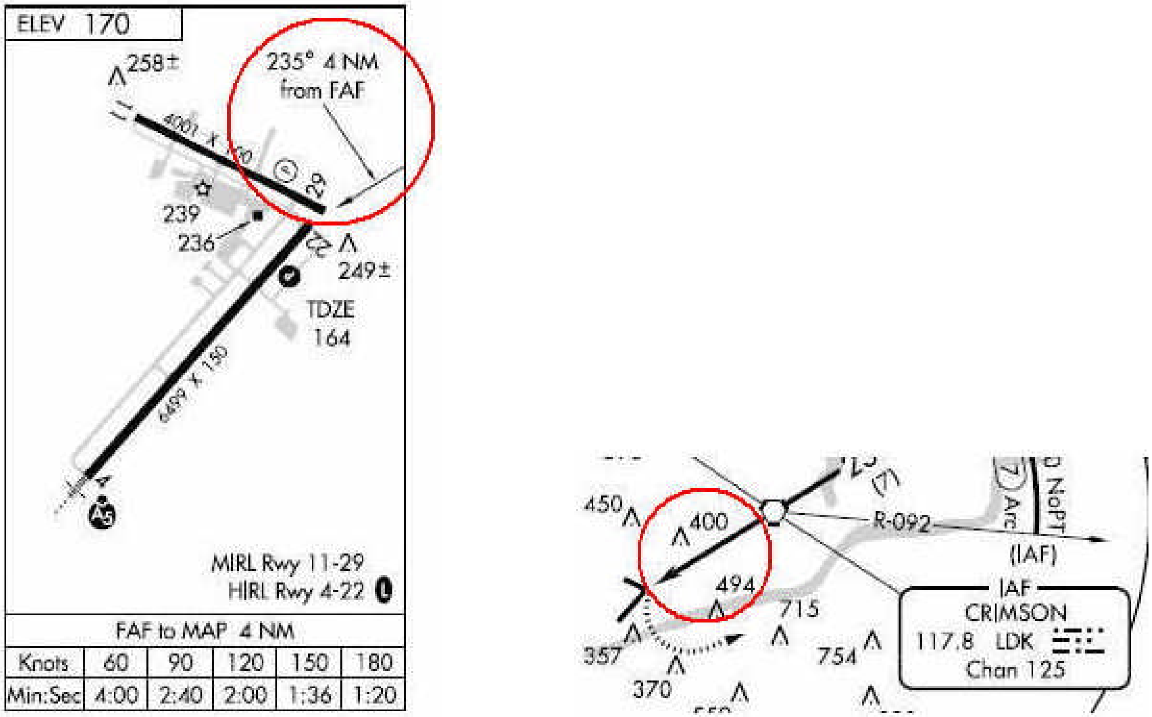


Figure 419 - Recognizing an offset approach.

Conducting a VOR approach is not any different than using a VOR for navigation from point A to B as discussed back in chapter 3 "Navigation by VOR". It only becomes more tedious as settings have to be changed quickly as the approach progresses. So you do need a good understanding of when and where to recognize making these changes. You also need to understand the VOR technicalities and concepts and if you skipped that portion of the manual I'd take the time now to read or review chapter 3 "Navigation by VOR". You must understand how VOR radials and the TO/FROM flag works, the basic VOR characteristics. I'll be touching base with that again here but the more information you put in your cranial repository the better <grin>.

Since I have described the procedure turn and NoPT (no procedure turn) concepts in the other examples here I'll introduce you to the DME Arc but before I go into this let me point out something about the IAF fixes.

If you were cleared to conduct the full approach (speaking again about the procedure turn here) the IAF that would be used is the CRIMSON (LDK) VOR. Notice in figure 419 right the box where you find the frequency for the VOR, it tells you the VOR is an IAF (the IAF is positioned in the box border). This is the appropriate IAF for the procedure turn.

There are three methods to conduct the VOR approach without a procedure turn (NoPT). The first is of course by vectors-to-final provided by an online controller. The second is via the BROOKWOOD (OKW) VOR from where the procedure turn is not required. The final method is via the DME Arc where again the procedure turn is not required. Notice the DME Arc can be started from two sides. Look at figure 420 points A and B.

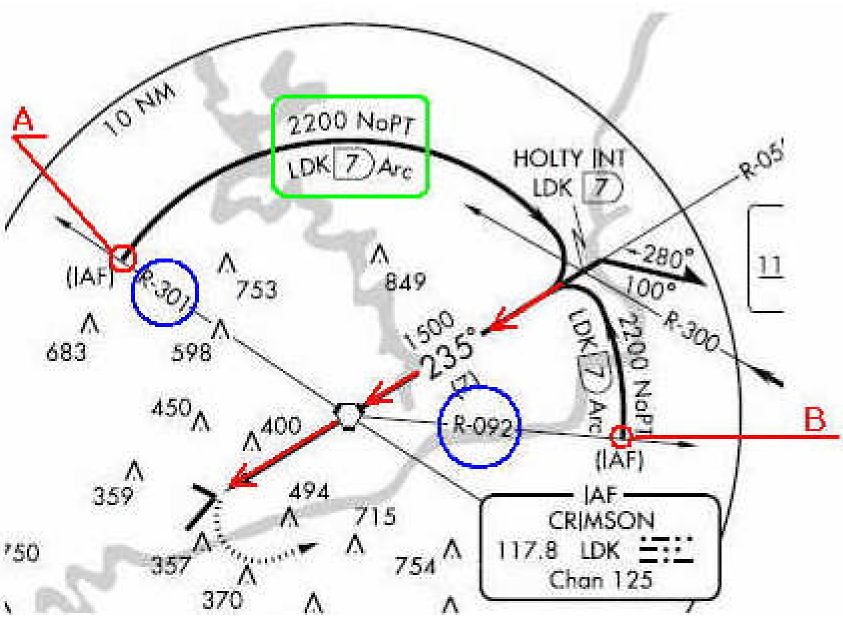


Figure 420 - The DME Arc approach to RWY 22.

Using the VOR and your DME equipped aircraft these two points are easily located. Typically you would fly to the IAF directly from any direction choosing the IAF on the side of the approach course you're approaching from for intercept of the arc reference figure 421.

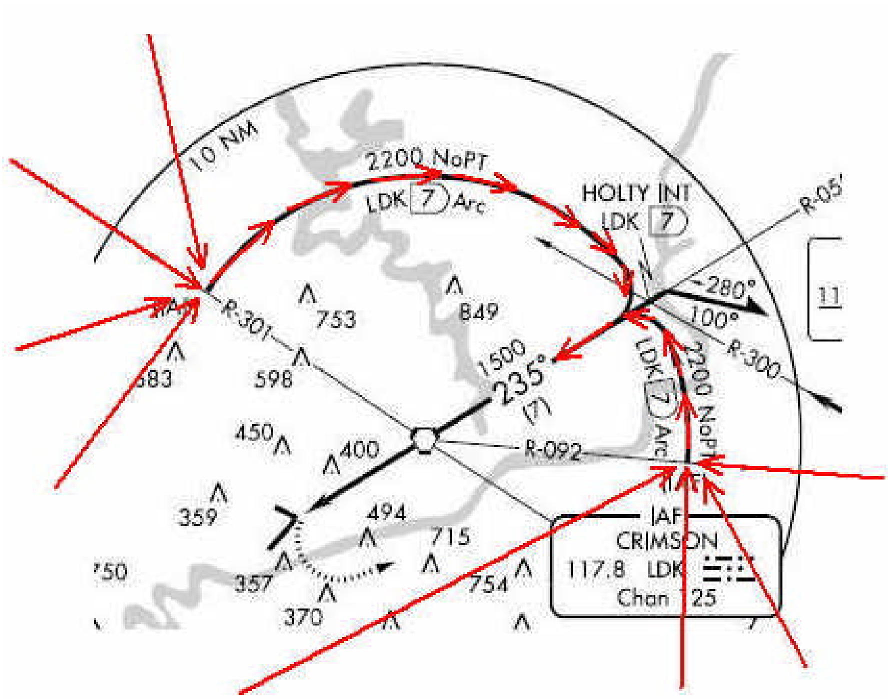


Figure 421 – Example interception routes to conduct the DME Arc approach.

If required (such as the need for time to descend from a higher altitude) you could skip the IAF on the side you're approaching from and fly to the VOR, then cross it, to fly outbound on the indicated radial to the IAF then start the DME Arc procedure (reference figure 422).

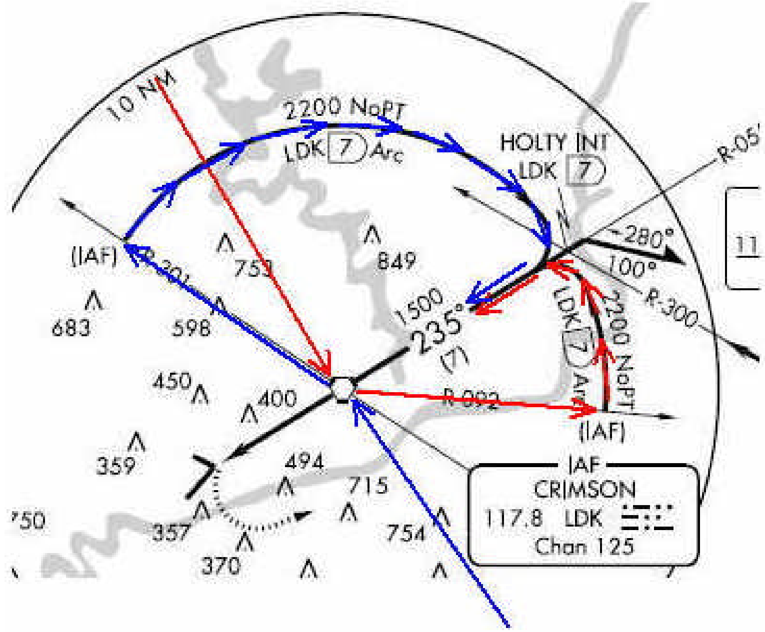


Figure 422 - Over flying the VOR to intercept the DME Arc.

The choice is yours depending on the situation or how the controller clears you to conduct the approach (the controller may stipulate in the clearance instructions how you must intercept the DME Arc). I'll explain the DME Arc from the perspective of flying to the IAF closet to you, and in this case on the radial that establishes the IAF itself. If you fly inbound on the radial take caution, the radial bearings shown circled in blue (reference figure 420) are the outbound radials or in other words the VOR FROM radials in relation to the VOR transmitter) so be sure when tracking *inbound* to get a TO flag indication and not a FROM flag indication so the CDI indications on the VOR gauge being used are proper for course corrections. So for instance, let's look at using the IAF at point A (again reference figure 420) for this example (intercepting and conducting the DME Arc from point B is done using the same methods I'll explain for point A here). If you are flying inbound on the R-301 radial you would need to set the OBS knob on the VOR1 or VOR2 gauge (depending on which one you are using) so 121° (the reciprocal bearing for 301°) is at the top of the gauge to provide a TO flag indication for proper tracking inbound using the VOR gauge.

All that is required now is to watch the DME display. Be sure the DME receiver is coupled to the VOR gauge you are using to track the radial. Use the R1 switch (to couple to the VOR1 gauge) or the R2 switch (to couple to the VOR2 gauge) on the DME panel which is typically located in the radio stack such as provided on the default Cessna aircraft (note that the switch may be labeled differently on other aircraft). Now look for the 7nm measurement. When the DME displays (measures) 7nm you make a 90° left turn (the inbound heading 121° minus 90° for a left turn equals the initial DME Arc heading of 031°) to get you on the arc. After you turn to the initial heading of 031°, if you maintain this heading exactly you'll see the DME distance steadily increase again as the 031° heading would eventually cause you to fly outside the arc. So as the distance starts to increase you must make gradual turns (in this case) to the right to keep the distance at 7nm from the CRISMON VOR (where your DME measure source is coming from). There are various real-world techniques to do this but it should be simple enough (with practice) to add a few degrees turn to the right as you progress along the arc to maintain the 7nm display.

As you approach the final approach course near the HOLTY intersection (reference figure 422) you'll need to intercept the VOR 235° radial TO (TO as in the TO flag again) the VOR. So as you progress around the arc keep turning the OBS knob to see where you are along the arc (by keeping the CDI needle centered) and eventually as you approach the 235° radial (the 235° setting will approach the top of the VOR gauge) set the OBS setting to this final heading (under the pointer at the top of the gauge) and turn the aircraft to track inbound on the 235° radial along the blue arrow in figure 422, once established on the 235° radial inbound to the VOR you can descend the aircraft to 1500 feet MSL (note the altitude just above the 235° annotation on the inbound course in figure 422. Maintain 1500 feet MSL until reaching the FAF (the final approach fix in this case is the VOR). After crossing the FAF you can descend to the published MDA of 700 feet MSL (reference figure 423) for a category A or B aircraft (in this example our aircraft is the default Cessna a category A aircraft). This approach requires at least a 1 statue mile visibility so don't forget to check the host weather provided (during an online activity the controller should advise you if the weather is below minimums for the approach). From there you follow the normal methods of acquiring the runway, and if not acquired execute the missed approach.

CATEGORY	A	B	C	D
S-22	700-1 536 (600-1)		700-1½ 536 (600-1½)	700-1¾ 536 (600-1¾)
CIRCLING	800-1 630 (700-1)		800-1¾ 630 (700-1¾)	800-2 630 (700-2)

Figure 423 - Aircraft Category Minimums.

Again, if an online controller is vectoring you to intercept the DME Arc approach (you'll most likely be vectored to intercept the IAF point closet to you) the controller will most likely clear you for the approach just before reaching the IAF. You'll conduct the DME Arc procedure on your own using the appropriate approach chart. Do not expect an online controller to vector you through the DME Arc as these are better done by the pilot else the controller must provide constant vector instructions to compensate for the arc which in this case would not be typical. So if you plan on or are told to conduct a DME approach you may want to have the proper approach chart handy. As always if you use the GPS 500 to conduct the DME Arc approach it will take all the work out of this for you. I'll discuss DME Arcs again under the discussion about GPS approaches.

Of course if you are cleared to conduct the full VOR approach then you must complete the procedure turn. This is done exactly as would be done for a full ILS or localizer approach previously discussed. You would approach the IAF for the procedure turn (which is the CRIMSON VOR itself) and then fly outbound on the VOR radial 055° until just past the 7nm DME point. Then you would turn outbound on the procedure turn (heading 100°) for approximately 1 to 2 minutes, then turn left (in this case) 180° to an inbound procedure turn heading of 280° to intercept the final approach course of 235°. Once established on the VOR 235° radial inbound you can again descend the aircraft to 1500 feet MSL until reaching the FAF. After crossing the FAF you can descend to the final MDA which in our example using a category A aircraft is 700 feet MSL with a required visibility of 1 statue mile.

NON-DIRECTIONAL BEACON APPROACH (NDB)

The non-directional beacon approach is one of the oldest instrument approaches around. These small, cheap transmitters provide a more crude method of tracking to or from the transmitter. The most critical thing for a pilot to be aware (or beware) of while conducting an NDB approach is wind drift. The localizer and VOR approaches provide a distinct method of properly tracking a predetermined path on the ground. The NDB signal does not provide this distinct capability so subsequently the pilot can drift away from a predetermined ground path if the NDB signal is improperly tracked. Literally the ground path can become "bowed" due to cross winds allowing the pilot to be either left or right of the proper approach path. Depending on the airport and surrounding terrain and obstacles this can become very dangerous. So conducting an NDB approach, especially in conditions of high winds can become quite a challenge. Again, if you skipped the section "Navigation by NDB in chapter 3 I highly recommend you go back now and read it or review it. I'll explain the problem tackling wind drift while tracking an NDB signal during an NDB approach again here but as with the VOR approach you must understand basic NDB concepts and tracking to make a successful NDB approach.

For this example I'll use the NDB RWY 15 approach at Kit Carson County CO (KITR).

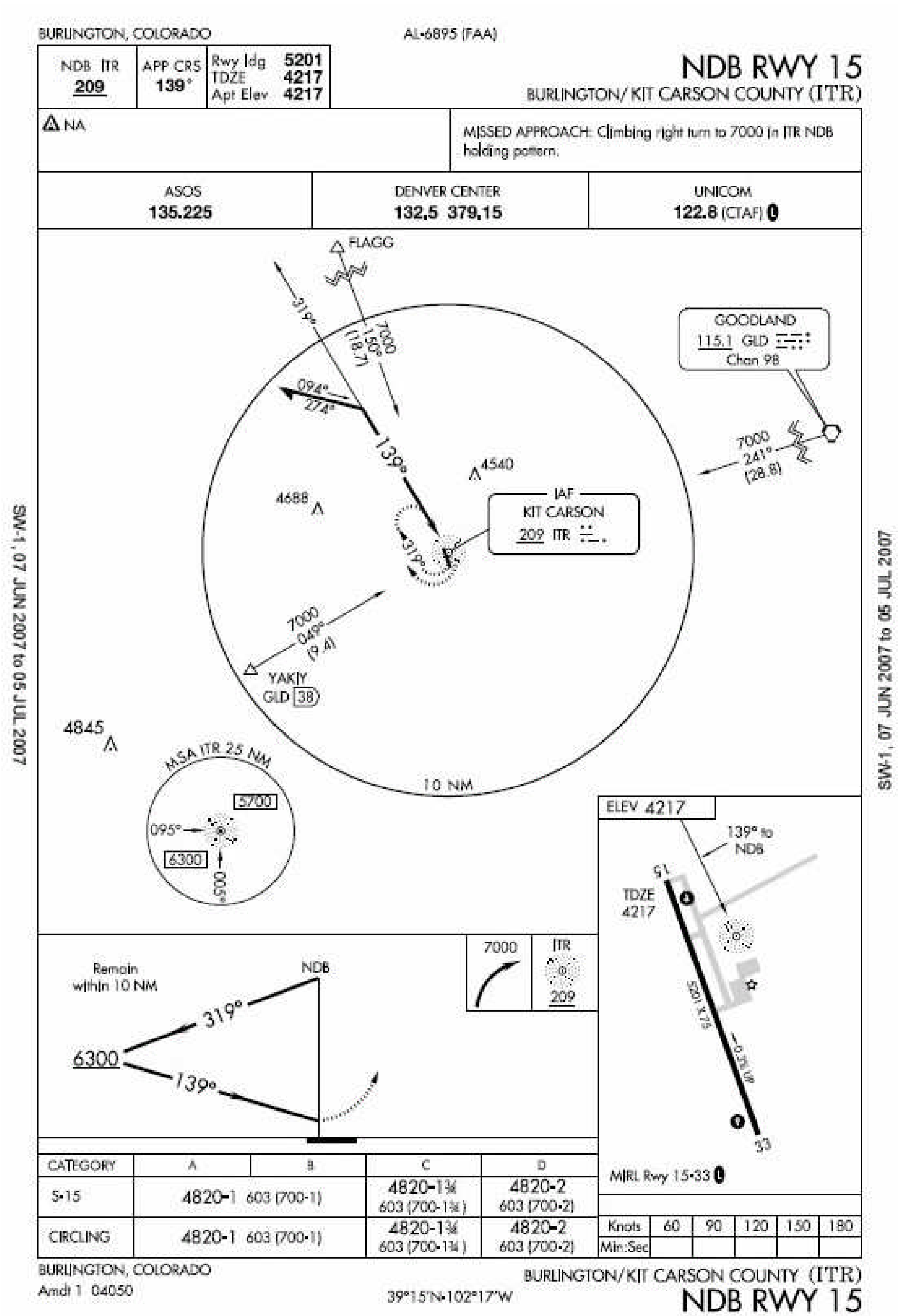


Figure 424 - NDB RWY 15 approach at KITR.

Just like in the other approach procedures discussed the NDB is designed with similar elements such as the procedure turn and in this case a single IAF. So in this example you have two primary ways to conduct the NDB approach, by vectors-to-final provided by an online controller or via the full approach. If you notice in this case the full approach is required as the procedure does not include any NoPT options (no procedure turn options). There is no skipping it unless you receive vectors-to-final by a controller. In figure 424 there are three fixes provided along with transition information to get you to the IAF. If approaching from the west or southwest you could include the YAKIY fix in your flight plan. From it you can fly on a heading of 049° at 7000 feet MSL to reach the IAF (the KIT CARSON NDB) and then complete the procedure turn. If approaching directly from the south you would merely fly direct to the NDB itself.

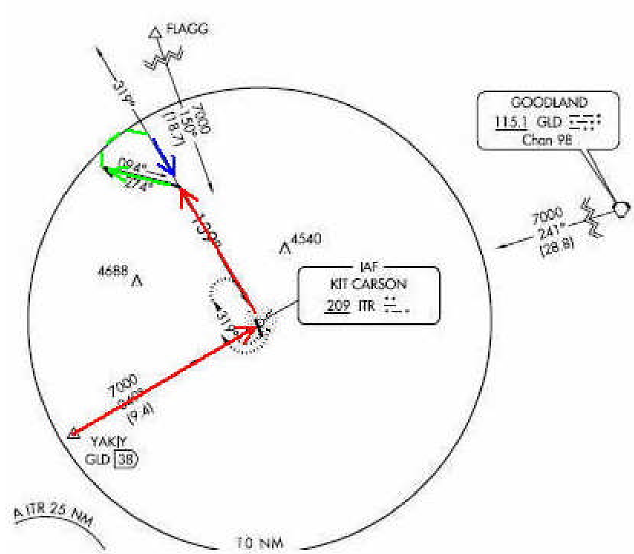


Figure 425 - Approaching the IAF from YAKIY

If approaching from the east you could include in your flight plan the GOODLAND VOR. From it you can proceed on a heading of 241° at an altitude of 7000 feet MSL to safely reach the IAF. NAVAIDs such as this are referred to as feeder facilities. Note the jagged double line symbol just left of the GOODLAND VOR. This symbol indicates the distance is not shown to scale on the chart. The same symbol is shown just below the FLAGG fix. So if you compare the approach chart view to a navigational chart these NAVAIDs will be some distance further out than the scale shown on the approach chart.

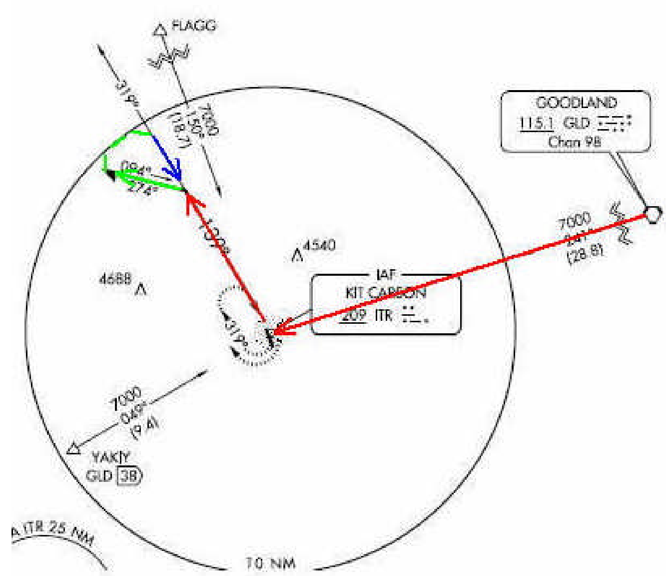


Figure 426 - Approaching the IAF from GOODLAND VOR.

The last fix to the north is FLAGG. Again if you include it in your flight plan you can proceed from it on a heading of 150° at an altitude of 7000 feet MSL to safely reach the IAF and conduct the procedure turn.

Now when approaching the NDB and just before reaching it, while flying straight and level, check your DG heading to ensure it matches the magnetic compass (a hint here, you can press the D key on the keyboard in FS9 to sync the DG to the magnetic compass). If you remember from chapter 3 "Navigation by NDB" you must "calibrate" the DG to compensate for gyro drift if you have this characteristic turned on in your flight simulator settings, reference chapter 3 for more information about this. This ensures the DG will provide accurate magnetic headings to adjust the NDB compass rose by.

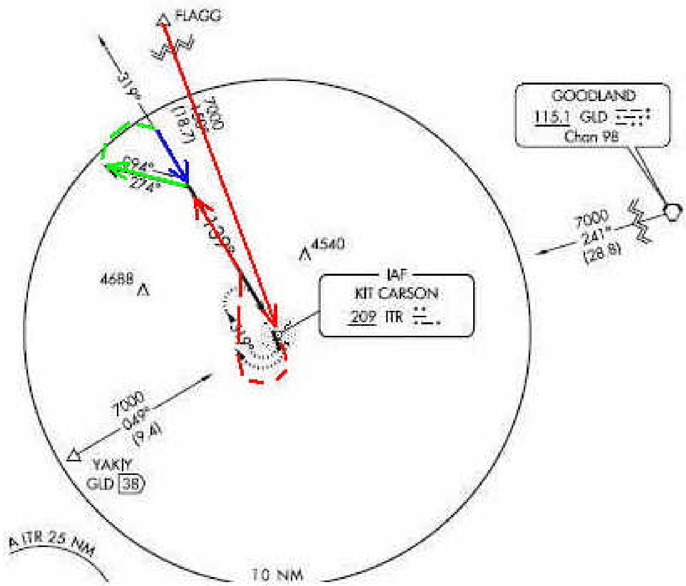


Figure 427 - Approaching the IAF from FLAGG.

In all cases, once you reach the IAF (KIT CARSON NDB) the pilot turns the aircraft outbound to track the 319° bearing FROM the NDB. Let me emphasize what I just said again, *you don't just turn outbound on a heading of 319°; you are to turn outbound and TRACK the 319° bearing FROM the NDB*. This means you are to stay on the "ground path/track" indicated by the line depicting the 319° bearing from the NDB (indicated in figure 427 by the red arrow pointed outbound). So let's discuss this skill using figure 427.

You'll approach the NDB from FLAGG on a 150° heading at 7000 feet MSL.

Figure 428 - Approaching the ITR NDB from FLAGG.

When you cross over the NDB you'll start a standard rate right hand turn (the red dashed line in figure 427) to a heading that will allow you to intercept the outbound heading at approximately a 45° angle, so 319° plus 45° equals 004°.

Figure 429 - The intercept heading to get established outbound for the procedure turn.

You need to quickly do some things with the directional gyro (DG) and the compass rose on the ADF gauge if you are using the default Cessna (remember, the ADF gauge compass rose ***MUST*** be set manually to the current DG heading when required, when using a standard ADF gauge, whereas the compass rose in a radio magnetic indicator (RMI) automatically follows the DG heading). RMIs are great to have during NDB approaches due to this characteristic where the RMI compass rose is "slaved" to the DG heading <grin>.

So, as you come back around on the 004° heading immediately set the compass rose on the Cessna ADF gauge to the same heading (004°) using the HDG knob.

Figure 430 - Make sure to adjust the ADF compass rose to MATCH the DG heading.

Keep adjusting the HDG knob to the current heading shown on the DG if it varies slightly. This is required so you can tell if you have reached the 319° bearing (ground track) FROM the NDB. Before you reach the 319° bearing the "tail" of the ADF gauge arrow will be nearing the 319° bearing on the compass rose (remember, the arrow "pointer" will always point in the direction of the transmitter which in this case is, or will be, shortly behind you depending on your aircraft speed).

The tail of the ADF arrow will "creep" to the right (clockwise) until it is on the 319° bearing (reference figure 431) where you turn back left to exactly 319° per the DG and start outbound FROM the NDB.

Figure 431 - The ADF pointer's tail indicating 319° while maintaining a 004° heading.

At this time set the ADF compass rose again to the current DG heading (which should be 319°). If you don't overshoot the turn (and you can lead the turn slightly to prevent this) you will now be on the proper 319° "ground track" proceeding FROM the NDB as seen depicted in figure 432.

Figure 432 – Proper ground track indications outbound on the approach.

As long as the aircraft is headed 319° (as indicated on the DG) with the ADF compass rose adjusted properly to this heading and the tail of the ADF arrow is pointing at the 319° heading on the ADF gauge you're on the 319° ground track FROM the NDB.

But what if there are cross winds causing the aircraft to drift off the proper ground track, how will you know this? What you will see while keeping the aircraft accurately heading on the 319° heading (per the DG) is the tail of the ADF arrow drifting either left or right depending on the winds. For example, let's say the wind is out of the east at 049° at 15 knots (that's a direct cross wind along the outbound and inbound track). Since you are steering the aircraft exactly on the 319° heading without turning the nose into the wind the aircraft will start drifting to the west. As it does the tail of the ADF arrow will now "creep" back to the left (counter clockwise) as seen in figure 433.

Figure 433 - ADF pointer tail "creeping" back left (counter clockwise) due to wind drift.

To correct this, use a simple rule of thumb, take at least half of the error shown and turn left. So if the aircraft is dead on 319° per the DG and the tail of the ADF arrow is now pointing at say 218° (as seen in figure 434) the difference is 10° divided by 2 equals 5°. Add 5° to 319° to get your new heading of 324°. Turn the aircraft right to 324° and immediately set the ADF compass rose to this new heading.

Figure 434 - Applying correction for wind drift.

Now watch the tail of the ADF arrow to see if it starts moving right (clockwise), back towards 319°. If it does turn the aircraft back left again toward 319° but instead of turning all the way to 319° leave some correction in place to compensate for the wind drift, about half of the initial correction applied (so your new heading to maintain would be approximately 322°). Keep watching for the ADF pointer’s tail to start any drifting.

If the tail does not come back right to 319° after applying your initial correction then you didn’t apply enough, now add another 5°, for a new heading of 329°, immediately set the ADF compass rose for the new heading and again look to see if the tail of the ADF arrow is moving back to 319°. Repeat these steps until the DG and ADF once again look like figure 432 which depicts the correct 319° ground track FROM the NDB.

Also, once you’re properly established on the outbound heading of 319° don’t forget that the procedure instructs you to descend and maintain 6300 feet MSL throughout the procedure turn. So after crossing the NDB you can start down from 7000 feet to 6300 feet MSL.

Figure 435 - Maintain 6300 feet MSL throughout the procedure turn.

Be aware that you don't have a lot of time to get the aircraft on the proper ground track. Looking at this approach chart the procedure turn needs to be completed within 10nm of the NDB. So if you spend too much time trying to achieve this then you'll extend your outbound leg farther than the 10nm limit. So aggressively get the aircraft on the proper ground track as quickly as possible. This is a skill which takes practice and each aircraft will be different (trust me, the speed in which you apply these corrections differs from a Cessna compared to a Learjet, things happen quickly so stay on your toes). You ***MUST*** complete the procedure turn within the 10nm limit for indicated altitudes on the chart to provide safe approach altitudes.

Well now, that was a lot just to get us on the proper outbound track to accomplish the procedure turn. How long were we supposed to travel outbound? This depends on your aircraft speed but a good rule of thumb is 2 to 3 minutes. The main thing to remember as I just mentioned, complete the procedure turn inside the 10nm limit as shown in this procedure from the FAF (the KIT CARSON NDB in this case).

So if I were in a Cessna, after approximately 3 minutes I would turn to a heading of 274° outbound in the procedure turn.

Figure 436 - Outbound heading of the procedure turn.

While outbound in the procedure turn don't worry about the ADF indications, your priority at this time is to accurately maintain the outbound heading per the DG for the approximate time required. Since I'm in a Cessna 172 I'll travel outbound for 2 minutes. This is done by using the chronograph (timer) provided in the cockpit (reference figure 437).

Figure 437 - Cessna chronograph timer.

When the timer shows 2 minutes has elapsed I'll make a 180° turn to the procedure turn inbound heading of 094° (the green dashed line in figure 427). Remember that when making turns keep them standard rate using the turn and bank coordinator gauge.

Figure 438 - Aircraft Turn and Bank Coordinator gauge.

The turn and bank gauge can be fairly accurate (it's all in the math <grin>). If you notice right under the ball it says 2 MIN. That means if you keep a turn standard rate (the aircraft wing tip on the mark and the ball centered as seen in figure 410) in 2 minutes you would complete a 360° turn. Example, if you start the turn from 090° and maintain the turn for 2 minutes you will again be at 090°. If you start a turn from 180° for 1 minute and roll out level you will be heading approximately 360° north.

So, as soon as you roll out on the 094° heading inbound immediately set the ADF compass rose to this heading (reference figure 439) and start watching the ADF arrow (now that you are going to intercept the inbound heading you watch the arrow pointer itself not the tail).

Figure 439 - Procedure turn inbound.

When the arrow points at the inbound heading of 139° (reference figure 440) turn to this heading (again it is okay to lead the turn slightly to prevent overshooting the ground track).

Figure 440 - ADF now indicating reaching the 139° bearing TO the NDB.

Again, when you roll out on the 139° heading immediately set the ADF compass rose to this heading. Check to ensure the DG is showing 139°, the ADF compass rose is set to 139°, and the ADF arrow is pointing at 139°, if so you are again smack dab on the proper inbound ground track reference figure 441).

Figure 441 - Proper ground track indications inbound on the approach.

Now before we forget the wind was out of the east at 049° at 15 knots. We already know we had to correct for wind drift on the outbound leg so why not go ahead and apply approximately the same correction inbound (I did make that simple by making it a direct crosswind <grin>) so turn the aircraft 8° to the left now on a heading of 131°. Set the ADF compass rose to this new heading. The

ADF arrow should remain pointing at the 139° bearing if the compensation for drift is correct as depicted in figure 442.

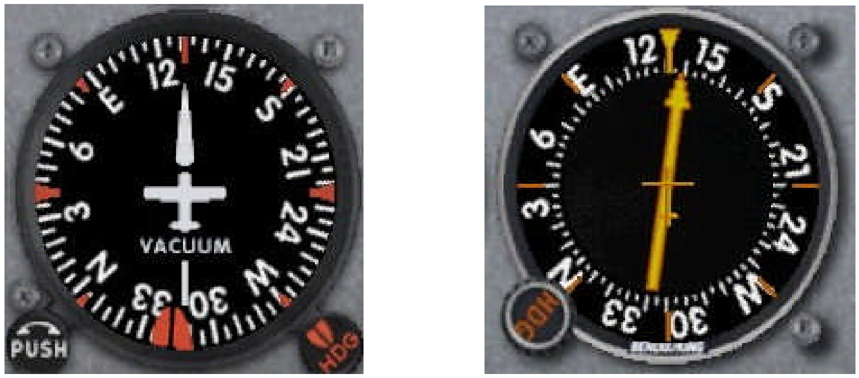


Figure 442 - Applying wind drift correction inbound on the approach.

If the arrow does start to drift then you'll again need to apply more correction as you did on the outbound leg. Let's say the wind is gusting to 18 knots now causing you to drift more to the west. The ADF arrow will "creep" to the left (counter clockwise) as you deviate farther from the proper ground track to the west.

Figure 443 - ADF pointer creeping counter clockwise after making an initial correction for wind drift.

Turn the aircraft 5° more to the left into the wind. Set the ADF compass rose to the new heading on the DG (which should now be 126°). Now watch the ADF arrow and see if it creeps back to 139°. If you have enough correction applied it should. Again when the arrow points at 139° you are over the proper ground track (reference figure 444).

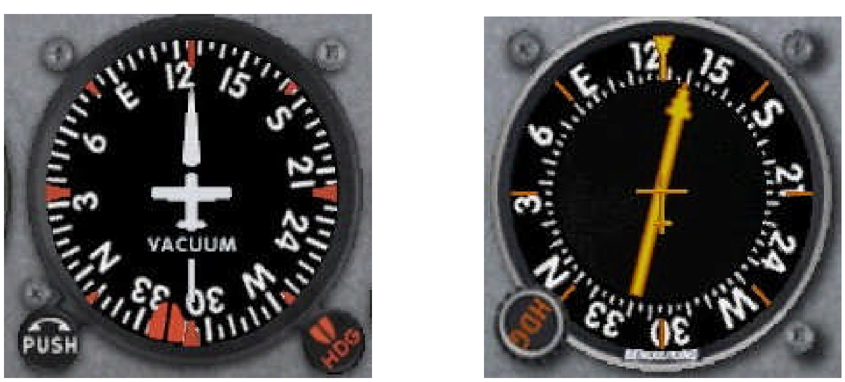


Figure 444 - Back on the proper ground track after applying additional correction for wind drift.

Now take out some of the correction (if you don't then you'll deviate left of the proper ground track), say 2.5° (don't take it all out or you'll start drifting west again, just take out a little to help maintain your proper ground track as seen in figure 445).

Figure 445 - Tweaking the wind drift correction during the final approach.

Since the NDB is located on the airport in this approach you do not have to use the chronograph to time your approach (as would be the case if the NDB were located off the airport at a remote location, hence there are no times shown below the airport obstacles top-down view where it has the columns for knots (they're all blank in this case as seen in figure 446).

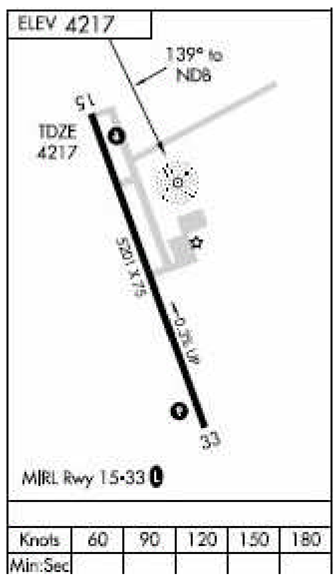


Figure 446 - No approach timing is required during this approach.

The MAP is the NDB. So as you track inbound you'll be watching for the ADF arrow to "flip" behind the aircraft indicating you crossed the NDB as depicted in figure 447. The pointer could flip in either direction depending on the aircraft's position relative to the NDB transmitter (either just left or right when over flying the NDB).

Figure 447 - ADF pointer "flipping" or "swinging" to the rear of the aircraft after passing the NDB transmitter.

If you do reach the MAP without proper acquisition of the runway then start executing the missed approach procedure as published. In this approach the missed approach procedure is quite simple, start a right hand turn to proceed directly to the NDB while climbing to 7000 feet MSL. As you again reach the NDB enter a holding pattern (right-hand turns along the 319° ground track) directly over the airport at the NDB (continuing climbing until you reach 7000 feet MSL).

Apply the above tracking techniques to maintain the proper inbound heading (the 139° heading TO the NDB) in the holding pattern. When outbound in the holding pattern you only need to maintain the 319° heading for the required time (in the Cessna this is approximately 2 minutes) using the timer. Apply any required correction for noticeable wind drift. I'll be discussing holding patterns more shortly.

If you plan to conduct the approach again all you need do is depart the holding pattern ***AFTER*** crossing the NDB in the holding pattern and turning to the holding pattern outbound heading. Just don't stop on the 319°, keep turning to the intercept heading of 004° to again intercept the 319° outbound bearing FROM the NDB and start the process over. If not you can depart the holding pattern as required to proceed to the alternate airport.

As with the other approaches the GPS 500 most likely has the data required (an approach overlay) to allow the pilot to use the GPS to monitor this approach. The GPS can conduct the entire approach including the procedure turn if you don't wish to do it manually as described. I discuss the various GPS approaches next.

GLOBAL POSITIONING SYSTEM APPROACH (GPS)

Back in chapter 3 I discussed "Navigation by GPS". The GPS system consists of satellites orbiting the earth that provide signals allowing us to plot horizontal positions very accurately and even vertical altitudes.

Specific GPS approaches are being established without the need for older waypoints, fixes, or navigational aids, using those established just for GPS approaches alone. Still, the GPS can serve to guide pilots along the lateral route using the traditional non-precision approaches (and even *monitoring* the precision approaches) that we have just discussed via approach overlays. So the GPS becomes a very handy tool in the cockpit providing for navigation and guidance through various approaches. The more you learn how to properly use the GPS you'll realize just how wonderful a device it is.

So again, the GPS can conduct most non-precision approaches (as long as proper overlay data exists within the GPS database) and also guide the pilot to intercept the localizer either to conduct a localizer or ILS approach. During the non-precision approaches the GPS can take care of all the lateral navigation requirements leaving only the vertical requirements for the pilot to tend to.

During precision approaches the lateral navigation requirements are again taken care of until the localizer is intercepted leaving the pilot to tend only to vertical (altitude) requirements. Once the localizer is intercepted the pilot switches from using the GPS to using the localizer for lateral guidance and in the case of an ILS the glide slope for vertical guidance. The GPS map can be watched as a secondary way to monitor the progress of the approach. So I'll again discuss each type of approach here but instead of using the traditional NAVAIDs exclusively to complete each approach I'll use the GPS to either conduct or supplement each approach where applicable. Remember that during online ATC activities the GPS is a great aid in making approaches go very smooth. Let's get started!

I'll start with the NDB approach we just discussed and work our way backwards through the procedures (NDB, VOR, Localizer, and ILS). The NDB approach requires the pilot to learn *hard to understand skills* and is plagued by *wind drift errors* but if we create data (known reference points such as a fix) to allow the GPS to plot a course to a specific fix we can create overlays for existing approaches (just about any approach). In the case of the NDB approach just discussed the GPS can eliminate problems with wind drift by providing exact guidance along a plotted course (an accurate ground track) keeping the aircraft within just feet of the course centerline by accurately calculating wind drift corrections for the pilot. If the pilot can select from the database any required approach then the pilot can effectively navigate thousands of approaches using the GPS as the source to "drive" the aircraft autopilot leaving the pilot to tend primarily to the correct altitudes using the approach chart. Remember, the GPS 500 does not handle vertical navigation (altitude requirements) so as might be found within an FMC.

This allows the pilot to better manage the approach by putting some of the burden on the autopilot but don't forget, always be prepared for failures. If the autopilot fails then the pilot must know how to compensate for this by flying the GPS approach manually. If the GPS crump's then the pilot must revert to using the traditional NAVAIDs to complete the approach. In other words never become dependant or rely solely on the GPS and autopilot and forget the rest. Stay aware and keep all your skills sharp!

I'll place the aircraft on an airway approaching the FLAGG intersection to simulate this approach. From there let's load the above NDB approach for KITR into the GPS 500 (reference figure 424).

Figure 448 - Approaching the FLAGG intersection and preparing the GPS 500 for the NDB approach.

To load any approach the pilot starts by clicking on the PROC button (circled in red in figure 449). This will display a window on the GPS as shown in figure 449.

Figure 449 - Selecting an approach within the GPS database.

"Select Approach" should be highlighted by default when an approach has not yet been loaded. If one of the other selections is highlighted then you need to highlight "Select Approach". There are two ways to do this. The first way is to put your mouse cursor over either arrow on the large knob, then click the left mouse button. Clicking the left arrow it is like turning the knob counter clockwise. If you click on the right arrow it is like turning the knob clockwise. This will cause the GPS cursor to highlight the other selections. The second method (I prefer this method over the first) is to place the mouse cursor over either arrow then roll the mouse wheel either one click forward (away from you) or backward (toward you). This will have the same effect, moving the GPS cursor and highlighting the other selections. Again in our case highlight the "Select Approach" and then click the ENT (Enter) button on the GPS (not the keyboard ENTER button).

If you had a flight plan loaded with KITR listed as the destination then KITR should show up in the top field (airport field) as shown in figure 450. If you have no flight plan loaded or have used the direct-to button at any time then the top field of the next window will probably show the next waypoint the GPS is tracking TO. If nothing has been loaded the field will be blank. In figure 450 KITR is depicted as having been loaded as the destination and is already highlighted so the pilot doesn't have to enter anything here as it is what we want but the trick now is to move the GPS cursor to the approach field. Again the simplest way is to place the mouse cursor over the arrows on the large knob (circled in red in figure 450) and roll the mouse wheel toward you one click.

Figure 450 – Entering the correct airport for the approach.

This will move the GPS cursor one field down (in this case to the approach field as shown in figure 451). If the field does not open automatically to show all the approaches for KITR then place the mouse cursor over the arrows on the small knob and again roll the mouse wheel one click toward you. This will open a small window allowing you to continue to use the small knob to select the proper approach to be conducted (in this case the NDB 15 approach), once the proper approach is highlighted click the ENT button on the GPS.

Figure 451 - Selecting the proper approach.

When the ENT button is clicked the GPS cursor will automatically open the list of transitions stored in the database for the selected approach. Since we want to start the approach from the FLAGG intersection select FLAGG in the list and click the ENT button again.

Figure 452 - Selecting the proper transition.

Now the GPS will ask if you wish to load or activate the selected procedure but your asking yourself (I hope <grin>) what the difference is? Well, when you load the approach it is placed in the list of waypoints to be tracked by the GPS (in other words it becomes a part of your GPS flight plan) but these waypoints are not active, the GPS will not use them just yet. This allows the pilot to keep tracking other waypoints in the flight plan instead of the approach waypoints. If you activate the selected procedure the GPS immediately tries to track TO the first waypoint listed for the approach (in this case we selected the FLAGG intersection) from the aircraft's current location.

During online ATC activities (and just like in real-life) the controller will issue a clearance to the pilot to conduct the expected approach. Usually the pilot has been told which approach to expect ahead of time to allow proper preparations for it. The reason the FLAGG intersection was chosen in this case as the first transition waypoint is because it is on the "simulated" airway we are approaching the airport from (the transition). If the controller issues the approach clearance before reaching FLAGG then things will be easy because all that need be done by the pilot is to activate the loaded approach. If the controller issues the approach clearance after the FLAGG intersection then this will present a problem with the approach loaded as is.

So first let's take a look at what to do when the controller issues the approach clearance ***before*** reaching the FLAGG intersection.

You're approaching the FLAGG intersection and the controller clears you to conduct the full NDB approach. No problem, click on the PROC button. When you do the GPS cursor will now highlight "Activate Approach" by default because an approach is "preloaded" but not activated (reference figure 453). When the pilot clicks the ENT button the GPS will automatically start tracking TO the first waypoint in the approach (in this case we selected a transition from the FLAGG intersection so the aircraft will track directly to FLAGG which just happens to be the intersection we are approaching).

Figure 453 - Activating an approach.

From here the GPS is in complete control of the ***ENTIRE*** approach. Even if you go missed approach the GPS will guide you through it to the holding point and enter and fly the holding pattern until you tell the GPS what to do next (either fly the approach again or divert to an alternate airport). Remember, the pilot is responsible for maintaining the published altitudes during the approach just as described for the traditional NDB approach (without using the GPS).

Now what if the controller didn't provide the clearance until after passing the FLAGG intersection? Well for sure the pilot does not want to activate it as loaded because once activated the GPS ***ALWAYS*** proceeds to the first approach waypoint. So in this case if the waypoint is behind you and you activate the approach the aircraft is going to turn around and proceed back to the FLAGG intersection to start the approach. For sure this will get the controllers attention because you're expected to continue the approach from your *current position!* So what is the pilot to do?

You'll need to work fast (again that's why you get paid the big bucks <grin>) and click on the FPL button. This button opens the current flight plan waypoints (FPL = Flight Plan). You will see a window that resembles figure 454.

You'll notice the current waypoint the aircraft is tracking TO (highlighted by the GPS cursor) is the FLAGG intersection (which we have simulated passing already). So you need to "skip" the FLAGG intersection and tell the GPS to track directly TO the ITR NDB (the next waypoint in the approach).

Figure 454 - Skipping a waypoint or fix in the flight plan list.

Since the GPS cursor is visible already all you need do is place the mouse cursor on the arrows above the large knob. Roll the mouse wheel toward you until the GPS cursor highlights ITR under the listed waypoints for the NDB 15 approach as seen in figure 455.

Figure 455 - Selecting the waypoint to track TO.

Once ITR is highlighted click the MENU button, now you'll see a window as shown in figure 456. Figure 456 will show the new leg the GPS will track, FLAGG direct ITR.

Figure 456 - Activating the new leg.

If the GPS is coupled to the autopilot an intercept will be plotted to guide the aircraft to the straight line between the FLAGG intersection and the ITR NDB as seen in figure 457. If the aircraft turns sharply at first don't panic. If you have properly coupled the GPS to the autopilot as the source for guidance (select GPS on the NAV/GPS switch) and have the NAV mode selected on the autopilot the GPS will guide the aircraft to intercept the magenta line leading TO the ITR NDB. Sometimes pilot's don't allow the GPS enough time to stabilize the intercept before disconnecting it thinking something has gone wrong. Be confident by understanding how the GPS works.

Figure 457 - The new leg being tracked FROM FLAGG intersection TO the ITR NDB.

As mentioned before the GPS will now guide the aircraft through the entire approach procedure including the missed approach if required.

If the pilot does go missed approach and elects not to attempt the approach again but rather go direct to the alternate then all the pilot need do at this point is click the direct-to button and enter the ICAO for the alternate airport. The GPS will plot a course directly to the alternate. Remember that once you use the direct-to button in this manner any previous flight plan is completely replaced (at this point it shouldn't matter as the initial flight plan will no longer apply).

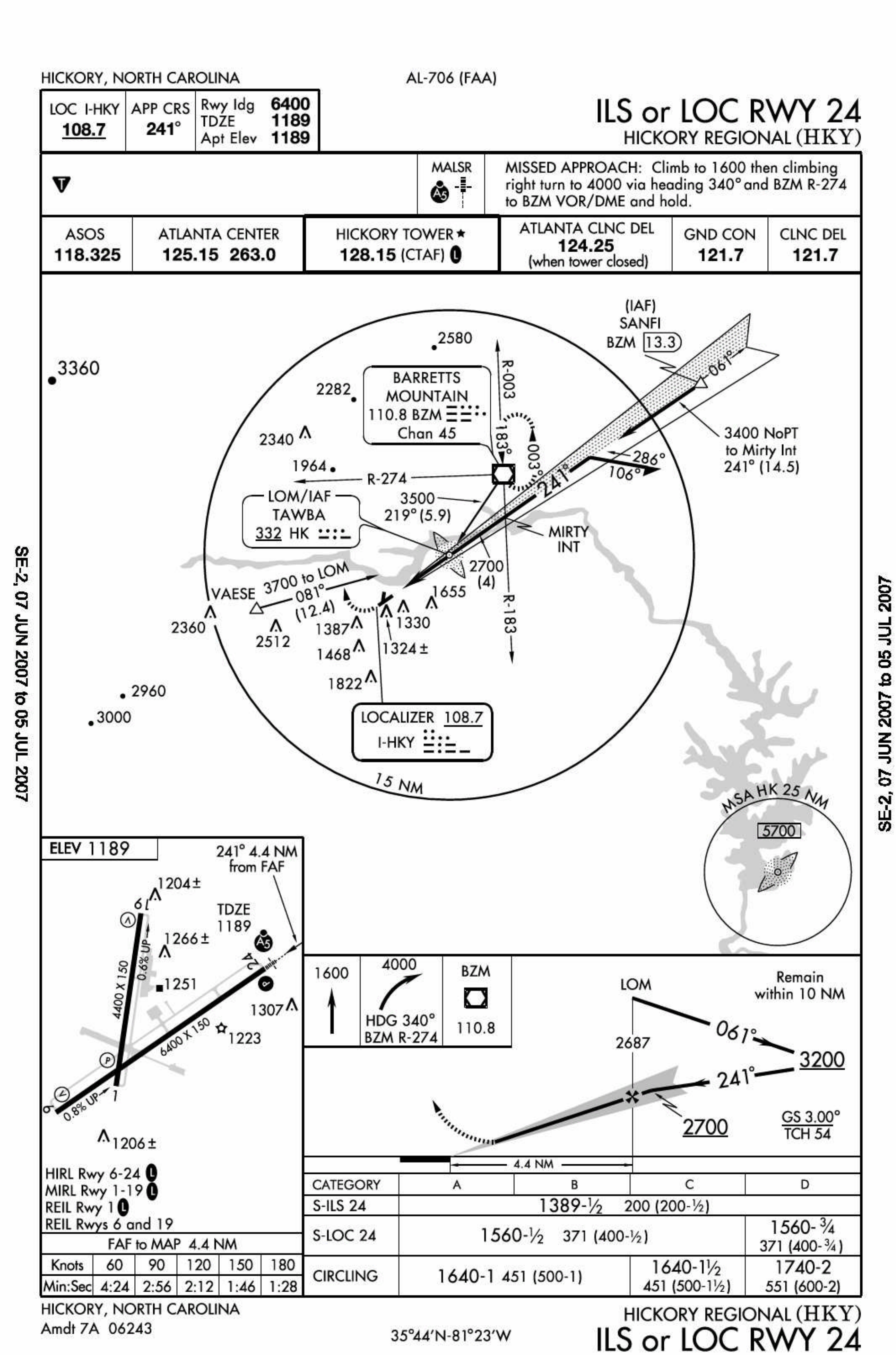
That's it when using the GPS to conduct an NDB approach. Now when it comes to conducting a VOR or even a VOR/DME Arc approach (also a non-precision approach) the GPS is used in exactly the same way as the above described NDB approach. The pilot selects the approach to be conducted (usually the approach as issued by the online controller). Select the transition as appropriate. If the controller tells the pilot the approach will be via vectors-to-final then select vectors-to-final as your transition. If the controller advises the approach will be a full approach select a transition waypoint that is closet to your arrival route. Remember, a full approach typically includes a procedure turn or entry holding pattern. The only time a pilot can skip these is if the published approach procedure allows a NoPT (no procedure turn required). *Only activate the approach in the GPS after the controller provides an approach clearance, otherwise follow controller instructions!* Read and understand your approach.

Now let's discuss using the GPS to conduct either a localizer approach or an ILS approach. There are some differences from that described above using the GPS to conduct an NDB or VOR approach. What are the differences? Well, in the case of the localizer or ILS approach the GPS is used only to get the aircraft established on the final approach course (or in other words the localizer beam). Once established on the localizer the pilot switches over to it for guidance. In the case of the non-precision

NDB or VOR approaches the GPS can conduct the entire procedure because the tracking is considered as good as the NAVAIDs themselves, whereas during the localizer or ILS approach these signals are considered more accurate (and safe) than the GPS signal, so accurate they can guide the aircraft down the runway centerline as during a CAT IIIC landing. There are still things about the GPS system that prevent it from being used for precision approaches (but the geek squad is working on this <grin>).

So as mentioned, the GPS helps the pilot intercept the final approach course. Once on the final approach course the pilot "tests" to see if the localizer is active and being received properly. If so then the pilot can couple the autopilot to the traditional navigation radios instead of the GPS for guidance along the localizer beam.

I'll retrieve the approach chart we used for our ILS discussion (earlier in this chapter) and review it here in figure 458. I'll simulate that the controller has advised us to expect the straight in approach for the ILS runway 24 at Hickory (KHKY). I'm approaching the airport from the northeast along Victor Airway V20 so I'll load SANFI as my transition waypoint for the approach (SANFI is located on V20). So my current GPS map might look like figure 459.



FAF to MAP 4.4 NM					
Knots	60	90	120	150	180
Min:Sec	4:24	2:56	2:12	1:46	1:28

CATEGORY	A	B	C	D
S-ILS 24	1389-½ 200 (200-½)			
S-LOC 24	1560-½ 371 (400-½)			1560-¾ 371 (400-¾)
CIRCLING	1640-1 451 (500-1)		1640-1½ 451 (500-1½)	1740-2 551 (600-2)

Figure 458 - IAP chart for ILS RWY 24 KHKY.

Figure 459 - Approaching SANFI intersection to conduct the ILS RWY 24 approach at KHKY.

Until the controller issues an approach clearance the pilot must follow either the filed flight plan or vectors being provided by the controller (in this case I'm simulating following the filed flight plan so far), including any altitude issued by the controller. Once the controller clears the pilot to conduct the approach the pilot becomes responsible for following the published procedure including all altitudes (but it doesn't hurt to know what these altitudes are even if the controller is providing them, remember that the pilot is ***ULTIMATELY*** responsible for the safety of the aircraft).

While approaching SANFI the minimum safe altitude (MSA) is 5700 feet MSL seen on the approach chart MSA circle (25nm from TAWBA NDB) in the approach top-down view. So it would be a good idea to stay above this altitude until crossing SANFI. After crossing SANFI the aircraft can be descended to 3400 feet MSL until reaching Mirty intersection. After Mirty the aircraft can descend to 2700 feet MSL until reaching the final approach fix where the aircraft follows the glide slope down to the DH at 1389 feet MSL.

As we approach SANFI the controller issues our clearance for the approach something like this, "N9COF cleared to conduct the straight in ILS runway 24 approach at Hickory. Advise when established on the localizer." This clearance puts the pilot in charge of the approach. This shouldn't be a problem because the GPS will guide the aircraft to the localizer where the pilot can couple the NAV1 receiver to the autopilot for the final approach.

Speaking of the NAV1 receiver this is a good time for the pilot to take care of the radios and stuff used for the ILS portion of the approach. You can obtain the frequencies for specific NAVAIDs from the approach chart but believe it or not the GPS packs these tid bits of information for your reference also. So let's find out what the ILS frequency is for the RWY 24 approach using the GPS.

If you're on one of the main map pages (you'll see NAV displayed just above the FPL button) then you need to flip to the WPT (waypoint group) of pages. If you remember from chapter 3 if you turn the large knob (while the GPS cursor is not displayed) different page groups can be selected. Once you are in the specific page group you can select the specific pages within a group using the small knob. So to reach the WPT group where we can find information on the current airport put your mouse cursor over the arrows for the large knob and roll the mouse wheel toward you one click. This should put you in the WPT group. If not just roll the mouse wheel backwards and forwards until you see WPT appear just above the FPL button.

Now once you are in the WPT group you can put the mouse cursor over the arrows on the small knob and select the different pages within that group. Each small square next to the WPT represents a page. There are seven pages in the WPT group and the third page is for airport information, so roll your mouse wheel to select the third page. Once on this page you can obtain an abundance of frequencies. If there are more frequencies than can fit on the single screen then click on the PUSH CRSR on the small knob to turn on the GPS cursor "on" then use the large knob to scroll down the list.

For the KHKY airport the ILS 24 frequency (in other words the localizer frequency) is 108.70 MHz. Dial this frequency into your NAV1 radio (not the NAV2 radio, remember the NAV2/VOR2 gauge is not equipped to follow a glide slope). Hint, if you scroll down the list and highlight the ILS 24, then click the ENT button, the frequency will be automatically loaded into the NAV1 receiver but ***WARNING***, the frequency is loaded in the standby side of the receiver only; *to make it active you must swap the frequency!*

Now rotate the OBS knob on the VOR1 gauge until the heading reflects the approach course heading of 241°. That's it for the Cessna 172, you'll be able to couple the autopilot at the right time to the NAV1 receiver and follow the localizer and glide slope.

We need one more thing for this approach, a cross bearing to identify the Mirty intersection. Why? Well the Mirty intersection identifies the point where the aircraft can start a descent from 3400 feet MSL to 2700 feet MSL along the approach path. The cross bearing is taken from the BZM 183° radial. You can find the frequency for the BZM VOR in the GPS by clicking on the NRST button and using the small knob select page 4 of the nearest (NRST) group. This page contains the VORs closest to the aircraft. Depending on your distance from the BZM VOR it should be listed first or very near the top. The BZM VOR frequency is 110.80 MHz. Dial this into the NAV2 receiver (you can not automatically enter it as done in the NAV1 receiver).

Now adjust the OBS setting on the VOR2 gauge to put 183° at the top of the gauge just above the arrow. When the CDI needle centers during the approach you have reached Mirty intersection.

Let's continue the approach. Crossing SANFI the aircraft can be descended to 3400 feet MSL as shown on the approach chart in figure 458. From SANFI the approach progresses to Mirty intersection. Now would be a good time to test for the localizer. A good rule-of-thumb is 15nm. Typically the NAV1 receiver will be picking the localizer up at 15nm or less without any problems. To check for the localizer signal switch the NAV/GPS source switch to NAV (you should have it set on GPS if you have been using the GPS to get this far). When switched the inoperative flags on the VOR1 gauge should not be displayed and the CDI needles should come "alive". To make sure you have the correct signal tuned temporarily turn on the NAV1 audio to see if the Morse code is that published for the localizer. If so leave the NAV/GPS in the NAV position to couple the NAV1 receiver to the autopilot and select the APR mode on the autopilot. All you need to do now is maintain the required approach altitudes as published.

Realize that when conducting an ILS approach like this that different ATC services will provide their controllers various guidelines on how and where to release aircraft to conduct an approach. Controllers may provide vectors-to-final until just before reaching the FAF. In such a case using the GPS to establish the aircraft on the localizer is of little use because the controller did this for you.

So you must learn to load the proper approach and expected transition to use depending on the situation. The arrival and approach is a highly fluid activity requiring the pilot to be very flexible and familiar with the GPS.

Localizer approaches that don't use a glide slope would be conducted just like the ILS approach. The GPS again provides guidance to the localizer beam where the pilot switches from the GPS to the localizer for guidance. Again depending on when the controller issues the clearance determines when the pilot must activate NAV guidance.

CIRCLING APPROACHES

You have probably noticed that located on many approach charts in the aircraft category table for approach minimums is parameters for a "circling" approach. What is a circling approach? Well, it starts with a precision or non-precision approach. Typically these approaches get the aircraft down to a specific circling MDA (*not the precision or non-precision minimums*) and when the pilot acquires the airport and runway environment, can circle the airport to land on a runway other than that used for the approach at the prescribed circling MDA. Why would you want to do this? Reasons can vary, but as an example let's say the winds favor a runway that does not have a published instrument approach (either precision or non-precision). Maybe another instrument approach is published but the equipment is not operable. The pilot would use one of the published approaches to safely descend to a point where the airport and runway environment can be acquired visually then while maintaining visual contact of the runway, circles to land on the runway which favors the wind direction and speed. *The key here is maintaining visual contact once made and not descending below the MDA while circling the airport.*

If visual contact is lost with the airport or runway environment while circling at the MDA the missed approach is executed. If a distinct cloud base is apparent over the airport circling approaches can work very well but if broken clouds mixed with ground haze and weather obscurities then circling approaches typically don't work well as the pilot will normally loose contact as the aircraft pops in and out of clouds.

So circling approaches provide the pilot with another option but must be used with caution. Follow the published minimums and don't compromise your safety. Let's go through a typical circling approach. I'll use the Asheville NC (KAVL) ILS RWY 34 approach as my example.

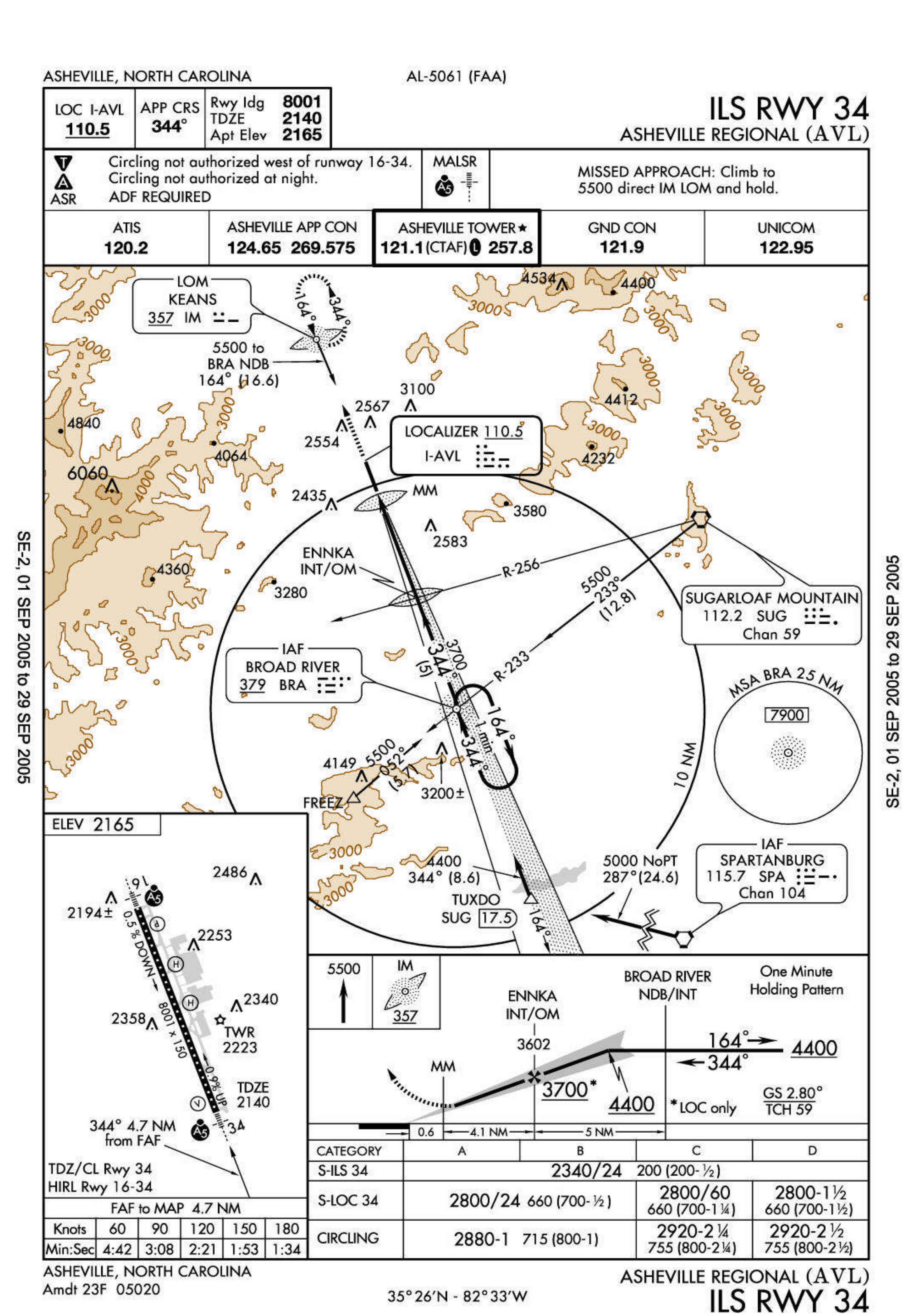


Figure 460 - The Asheville NC (KAVL) ILS RWY 34 approach.

At the bottom of figure 460 you can see the line in the aircraft category minimums table labeled "CIRCLING". The minimums provided in this line provide the pilot the minimums for a circling approach to runway 16 (common sense because that is the only other runway at Asheville <grin>). Notice for a Cessna 172 (category A) that the MDA is 2880 feet MSL ***WITH*** a 1 statue mile reported visibility. Again visibility gets higher to conduct this type approach. The aircraft will be circling approximately 715 feet AGL (note the 715 just after the 1 statue mile minimum) in a valley punctuated by mountains. So there is no room to fudge with the minimums (I know I wouldn't <grin>). The pilot can conduct the S-ILS 34 or S-LOC 34 approach down to the MDA of 2880 feet MSL if a landing is required on runway 16 such as for winds (again with the visibility being reported at or greater than 1 statue mile). If the pilot acquires the airport and runway environment before or at reaching the 2880 foot MDA and *can maintain visual contact throughout the entire circling maneuver* then the pilot can leave the precision or non-precision approach maintaining 2880 feet MSL, entering the airport pattern to circle to the landing runway, then line up and land. Notice also the minimums for the category C and D aircraft; the visibility really makes a jump, increasing to 2.25 and 2.5 statue miles respectively.

The circling approach can be made in either direction depending on the airport traffic pattern (most airport traffic patterns are left-handed). So if I were making this approach via the localizer for runway 34 and visually acquired the runway say at 2900 feet MSL I would turn slightly right to enter a left downwind pattern for runway 16 all while maintaining visual contact with the runway. If there were obscuring weather to this side of the airport but the right-handed pattern looked more favorable then report entering a right-handed pattern and go for it. Use the path of least resistance in this case. Also make note of all the surrounding airport obstructions and terrain features on the chart and keep an eye out for them.

If you do happen to loose visual contact with the runway environment while making the circling approach immediately execute the missed approach, in this case steering directly for the KEANS NDB. If you have already turned back south toward runway 16 when you lose visual contact make your missed approach turn over the airport (in other words do not turn away from the airport toward the mountains). In this case stay in the valley while making turns to get headed back toward the NDB to hold (or do as the online controller instructs since this is a controlled airport and you will most likely have a tower controller with you).

Circling approaches are not difficult. It starts with an operating precision or non-precision approach used to get the pilot down to the circling MDA. If the pilot acquires the airport and runway environment before or at this altitude the pilot can depart the approach used, maintaining the prescribed circling MDA to reach the runway used for the landing. If visual contact is lost execute the missed approach.

Note also that if more than one runway were available that the circling approach can be used to land on any runway other than the approach runway used as prescribed. Circling approaches again are great when the weather cooperates to help pilots use a runway more favorable for landing. Sometimes this just won't work due to the high visibility required where only an approach to lower minimums would work, so if all else fails be prepared to divert to the alternate if a safe landing can not be made.

SIDS AND STARS

This is one of the more hot topics for online ATC activities next to VFR operations. SIDs and STARs tend to be very confusing to many pilots, so I'm going to try and unravel the mystery of these enough to allow the typical online flight simulator pilot to use these in conducting a standard instrument departure (referred to now as a departure procedure) or the standard terminal arrival route.

The first thing to learn that will help get the mental picture correct is that both the SID and the STAR are a transition. It is a standardized procedure that either occurs just after takeoff or just before the approach to get aircraft safely on their way or safely started into an approach. The SID takes the pilot from the takeoff out and up to the en route (or cruise portion) of the flight whereas the STAR picks up the pilot somewhere along the en route portion or just after leaving it down to a point close to where an approach is started for landing.

A SID and STAR can be looked at very much like an approach plate. A SID or STAR chart is designed with an abundance of information available on the transition route and safe altitudes along the route. Many of the procedures provide "options" to the pilot such as various routes. The reason for this is because not everyone will depart to the north nor will everyone arrive from the east. So the charts are designed to be flexible concerning departure and arrival routes. Information is included for these routes such as the safe altitudes mentioned but also for the NAVAIDs used by the pilot to navigate the routes. If the pilot has the capability to load a SID or STAR into a GPS or FMC then these devices can instead provide what the conventional navigational transmitters provide for lateral guidance. An FMC can even provide for safe altitudes along the SID or STAR for vertical guidance.

Typically a SID or STAR always has a starting point and ending point. Sometimes these points match those of en route airways or initial approach fixes but sometimes they don't. Many may require a controller to properly conduct them (noted by "RADAR REQUIRED"), some do not. So it is important for the pilot to become thoroughly familiar with reading these charts. You'll find with a little practice that they are not as bad as some look (some are formidably complex) but once the route to be used is chosen then it is only a matter of extracting the information for that route.

Another matter of importance is how do we use a SID or STAR during an online activity? There are issues with this. In the real-world a controller typically will tell a pilot in-flight to fly per a given SID or STAR. The pilot is required to have these charts available to read and follow as instructed (or load into the particular navigational unit "on the fly" such as the GPS or FMC which would then guide the aircraft along the route).

In the online world things are different because not everyone has the required charts all the time. So we need to bend the rules a bit to accommodate users that might not have the printed charts handy. Another case may be that a SID or STAR is provided in a database for the GPS or FMC which is preloaded before takeoff. Some pilots do not know how to change these in-flight. So again, the online controller must know how to compensate for this and allow things to flow in a normal fashion. So it is important to learn ***WHEN*** and ***WHERE*** to load, or activate such procedures. Just like using a precision or non-precision approach for the landing, the pilot ***MUST*** again understand ***WHEN*** and ***WHERE*** to load and activate the approach depending on what the controller has instructed or things start going haywire. If the controller ***AND*** pilot have been properly trained then using a SID or STAR is no more difficult than conducting an instrument approach.

So let's dig into this topic and learn a bit about both the SID and STAR! I'll start with the SID as all aircraft start on the ground to depart. Then I'll progress to the STAR where the pilot eventually descends for the approach. Always remember, the SID and STAR is nothing more than a standardized transition either leaving or arriving at an airport. Not all airports have these but most major airports do where aircraft traffic is abundant.

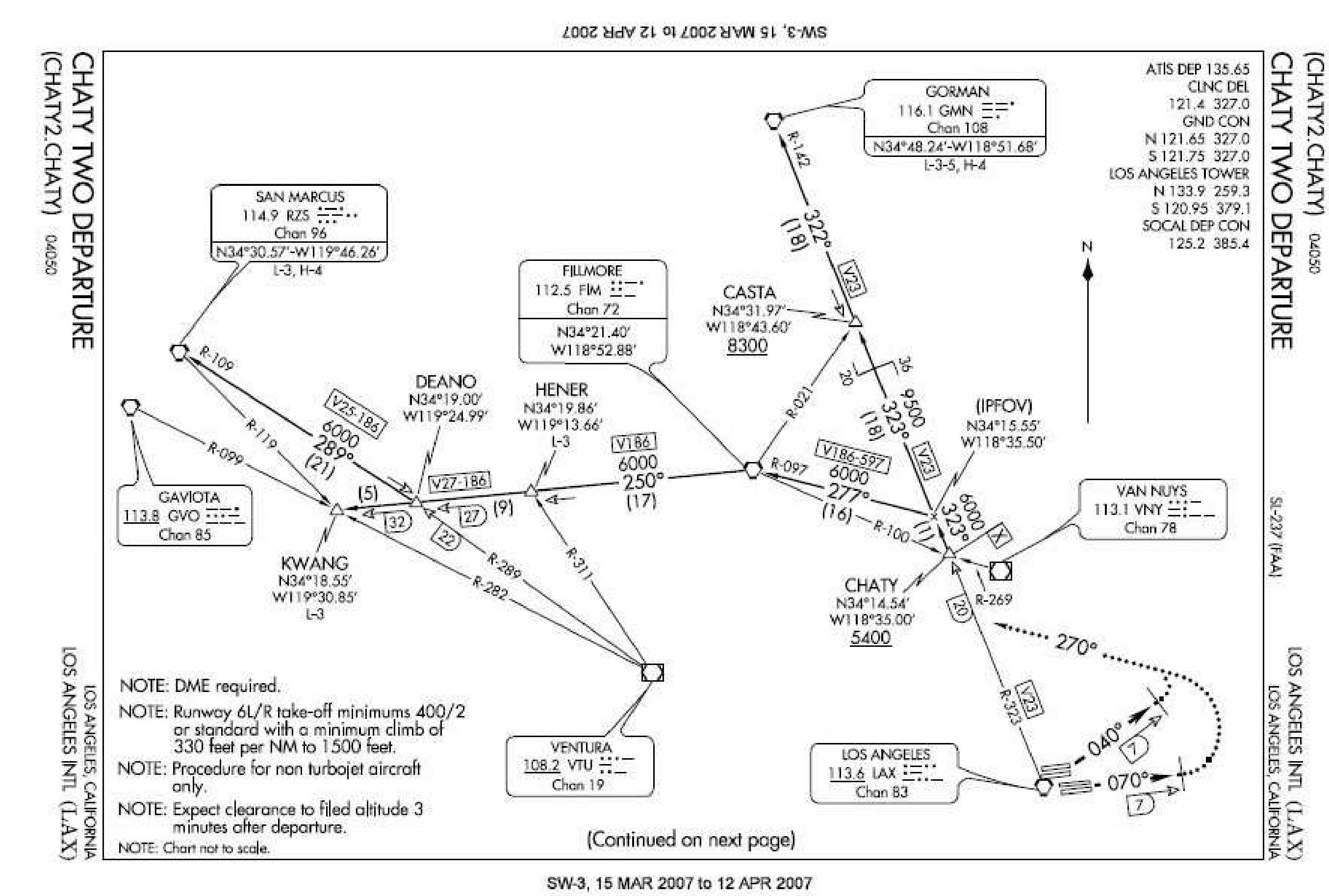
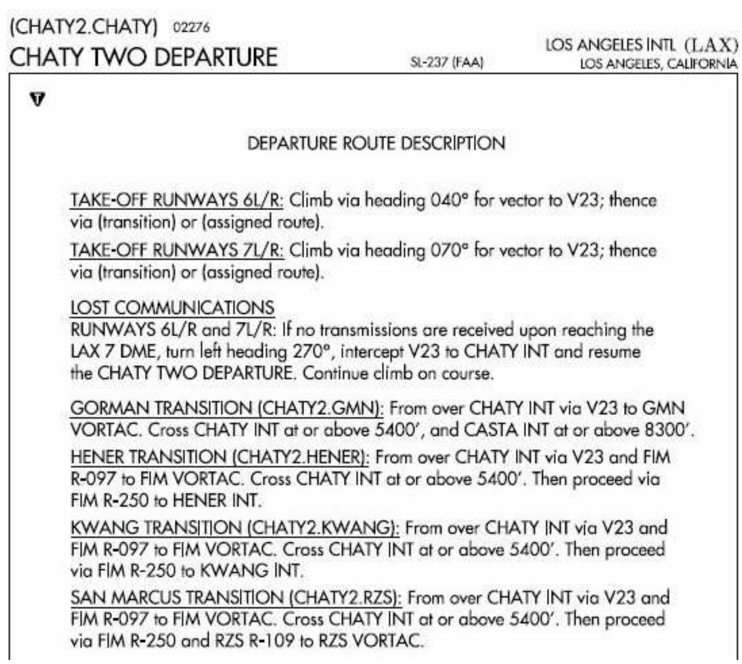


Figure 461 - Remember this one from an earlier chapter - the CHATY TWO DEPARTURE at KLAX.



(CHATY2.CHATY) 02276
CHATY TWO DEPARTURE SL-237 (FAA) LOS ANGELES INTL (LAX) LOS ANGELES, CALIFORNIA

DEPARTURE ROUTE DESCRIPTION

TAKE-OFF RUNWAYS 6L/R: Climb via heading 040° for vector to V23; thence via (transition) or (assigned route).

TAKE-OFF RUNWAYS 7L/R: Climb via heading 070° for vector to V23; thence via (transition) or (assigned route).

LOST COMMUNICATIONS
RUNWAYS 6L/R and 7L/R: If no transmissions are received upon reaching the LAX 7 DME, turn left heading 270°, intercept V23 to CHATY INT and resume the CHATY TWO DEPARTURE. Continue climb on course.

GORMAN TRANSITION (CHATY2.GMN): From over CHATY INT via V23 to GMN VORTAC. Cross CHATY INT at or above 5400', and CASTA INT at or above 8300'.

HENER TRANSITION (CHATY2.HENER): From over CHATY INT via V23 and FIM R-097 to FIM VORTAC. Cross CHATY INT at or above 5400'. Then proceed via FIM R-250 to HENER INT.

KWANG TRANSITION (CHATY2.KWANG): From over CHATY INT via V23 and FIM R-097 to FIM VORTAC. Cross CHATY INT at or above 5400'. Then proceed via FIM R-250 to KWANG INT.

SAN MARCUS TRANSITION (CHATY2.RZS): From over CHATY INT via V23 and FIM R-097 to FIM VORTAC. Cross CHATY INT at or above 5400'. Then proceed via FIM R-250 and RZS R-109 to RZS VORTAC.

Figure 462 - Partial view of page 2 for the CHATY TWO DEPARTURE.

The CHATY TWO DEPARTURE is for departing the KLAX runways 6L/R and 7L/R. Other SIDs may be published for the other runways at KLAX. Again, remember that a real-world controller would dictate the SID to be used based on current requirements at the airport. In the online ATC environment the pilot may be allowed to preload a SID of choice into the GPS (the default GPS 500 does not use SIDs or STARs) or FMC (most complex modeled aircraft GPSs or FMCs do include SID and STAR capability) and hopefully the pilot will remember to select the runway based on the online ATIS report and current server wind direction. This will typically apply to a STAR to be used at the destination (more on those shortly).

When the pilot preloads a SID then the pilot must make the online controllers aware that a SID and/or STAR will be used during the flight by indicating such in the flight plan filed via FSHost. Review chapter 3 “Flight Plans” for more information on how this is done. The online controllers will be looking for this in your flight plan. If either is indicated then they will issue instructions slightly different based on this information. They will know that vectors should not be issued by them but rather you intend to depart under control of the GPS or FMC guiding the autopilot concerning lateral navigation using a standard SID (you may still be provided altitude guidance though depending on the controller).

FS Navigator does have a SID/STAR database capability so the controllers can see the routes but pilots need to understand this is cumbersome to use. You’ll be expected to maintain the proper routing through the entire SID (some controllers will have the printed SID available so I’d try not to fudge the route <grin>). Even if the controller doesn’t fuss at you, in the background they may be asking what in the world you are doing <grin>. Remember it is incumbent for the pilot to stay on the filed route as closely as possible and that ATC has the responsibility to ensure you do also. Any deviations from the filed flight plan will probably get the controllers attention. Frequent or severe deviations from the flight route will probably result in the controller issuing vectors instead of allowing the pilot to navigate on their own.

Okay, so let’s say we’ll be departing runway 6L at KLAX. My airway just happens to connect to the SID at the San Marcus (RZS) VOR. So the transition I need to use on the chart is the SAN MARCUS TRANSITION (CHATY RZS).

In figure 461 there are several important notes to read. The first note (and an important one) is that DME is required. Just after takeoff from 6L the aircraft must be turned to a heading of 040°. The pilot will receive vectors to V23. Also note the takeoff requirements for runway 6L/R. There is a minimum climb requirement to overcome obstacles along the departure route, make sure your aircraft can meet the requirements. Another note tells the pilot to expect clearance to the filed altitude 3 minutes after departure and the last note reminds us that the chart is not to scale.

Now on page 2 of the chart are written instructions for the procedure. These should also be read thoroughly by the pilot. The first instruction is for takeoffs using runway 6L/R. This instruction tells the pilot departing runway 6L or R to steer a heading of 040° for vector to V23; thence via transition or the assigned route. So the pilot is to expect vectors to get to V23 then the pilot proceeds via further vectors (assigned route) or by the published transition.

Now notice the next instruction concerning lost communications. If the pilot receives no communications from the controller by the time they reach the 7nm DME fix from the LAX VOR the pilot is to turn left to 270° and intercept V23 to proceed direct to CHATY INT. Upon reaching CHATY the pilot continues on the CHATY TWO DEPARTURE continuing to climb on course.

Since I choose the SAN MARCUS TRANSITION I would proceed via V23 FROM the CHATY INT until I intercept the 097° radial FROM the Fillmore (FIM) VOR (in other words turning to a heading of 277° proceeding TO the VOR). Note that I’m to cross the CHATY INT at or above 5400 feet MSL. Upon reaching the FIM VOR I’ll proceed via FIM radial R-250 on a heading of 250° FROM the VOR until intercepting the RZS radial R-109 (at the DEANO INT) turning to 289° proceeding TO the RZS VOR. Note that the Ventura (VTU) VOR can help the pilot identify other fixes along the departure route.

Once I reach the San Marcus (RZS) VOR I can proceed en route as filed (in other words using the en route airways I have chosen). If the final point in the SID is not on the intended airway or route of flight then typically the pilot would fly ***direct*** to intercept the first point on the intended route. Also, if I were to have required a different transition (within this SID) then I would read and follow the instructions for that particular transition instead of the one I described.

Now you can see that following a SID is not as difficult as it looks. The hard part involves understanding how to integrate it into an online ATC environment. The pilot in this case could fly the entire SID manually, a great challenge and the most flexible way to manage it, or learn how to properly operate the GPS or FMC, loading the SID into either, and coupling the autopilot so as to guide the aircraft along the route. The problem with using the GPS or FMC is that the pilot must be prepared to uncouple the autopilot and follow the online controller's instructions on a moments notice or take over control of the aircraft when the aircraft does not react as expected. The pilot in such cases will be expected to follow the SID regardless so be prepared (it pays to practice doing SIDs manually until you become proficient with them).

The pilot can not always be guaranteed a perfect flight based on the flight plan s/he loaded in the GPS or FMC so it behooves the pilot to learn how to properly modify the flight en route using either device. Controllers should be instructed to accommodate the pilot as best possible but this will not always be possible. Both controller and pilot need to remain flexible.

Now let's take a look at a STAR. As mentioned a STAR is a standard transition used to arrive at the destination airport. Typically the first fix on the STAR may be, as compared to the SID, a fix on an en route airway or not. If the first fix is not on the flight route then the pilot would depart the flight route at the most convenient point along the route to intercept the STARs first fix. From there everything works in reverse when compared to the SID just described. Read the instructions for the route and note any transition altitudes required. When you reach the last fix in the STAR it will either be one of the initial approach fixes for an instrument approach, or it may dead end, requiring vectors from the controller, or you might proceed from the last fix in the STAR and proceed ***direct*** to the IAF. It depends so follow any instructions provided.

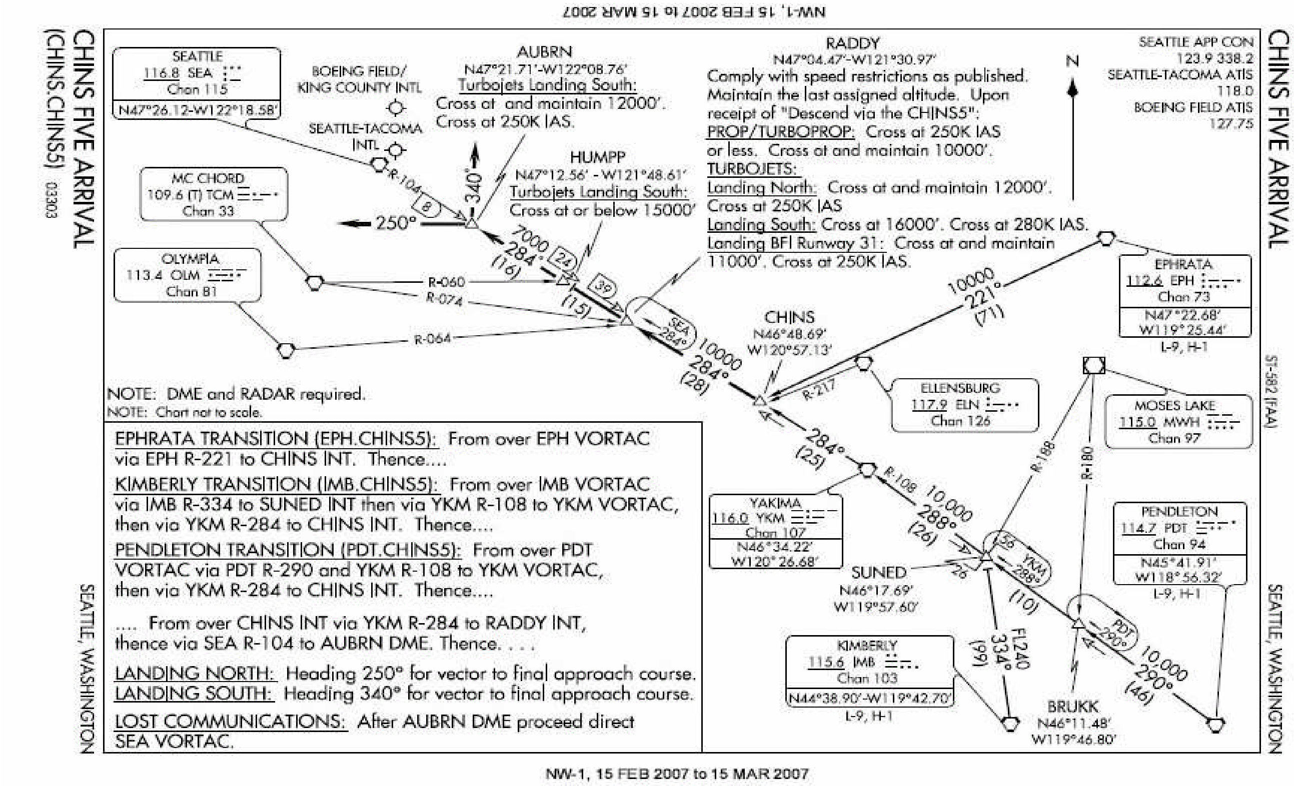


Figure 463 - The CHINS FIVE ARRIVAL at Seattle Washington (KSEA).

In figure 463 the CHINS FIVE ARRIVAL for KSEA is depicted. Again there are important notes to pay attention too. Once again DME ***AND*** Radar (in other words a controller) are required to conduct this arrival. Also it is noted that the chart is not to scale. Notice on this chart the special notes for the RADDY INT. Read all the notes and apply them as would be applicable to your case. The arrival instructions are encased in the square block in the lower left of the chart. Again, the pilot reads the instructions as apply to the arrival route being used.

So, for instance, let's say we'll arrive via the EPHRATA TRANSITION (EPH.CHINS5). By the way, let me point out something you'll probably run across at some time or another. If you notice in the arrival name I just gave you, EPH.CHINS5, you can see that the transition is written first and then after the period is written the name of the STAR. The same was true of the SID above, CHATY2.CHATY, written in reverse. The name of the SID is written first, CHATY2, then after the period the transition name, CHATY. If you put a SID name and a STAR name together the transition is always in the middle as seen here, CHATY2.CHATY – EPH.CHINS5. Online controllers should know this because when the pilot includes a SID and/or STAR in the flight plan it will be easily understood.

Arriving over EPHRATA (EPH) VOR you would proceed via the EPH radial R-221 FROM the EPH VOR to CHINS INT then thence… (Thence in this case means you need to skip the instructions for the other arrivals and pick up reading where it says …From). So, from CHINS INT we proceed via the YAKIMA (YKM) VOR radial R-284 to RADDY INT, thence via SEA VOR radial R-104 (in other words on the 284° radial TO the SEA VOR) to the AUBRN fix established via the 8nm DME from the Seattle (SEA) VOR and thence…

From here you must read the instructions based on whether you will be landing either on a north runway or south runway. It should be obvious that the controller must tell the pilot which to expect before reaching this point. Now you can see why ***RADAR*** is required to conduct this arrival. If the controller advises the pilot they will use 34R for landing at KSEA then the pilot will turn to a heading of 250° upon reaching the AUBRN DME fix and then complete the approach via radar vectors issued by the controller. If the aircraft will be using runway 16L for landing at KSEA then the pilot will turn to a heading of 340° and then complete the approach via radar vectors issued by the controller.

If communications are lost after passing the AUBRN DME fix then the pilot is to proceed direct to the SEA VOR. Note that this arrival has many airspeed and crossing altitude restrictions. This is a case where the pilot, while en route, needs to review the approach well in advance. Make sure to understand the minimum safe altitudes. The arrival route is in close proximity to Mount Rainier. It would not pay to either be off course or below the required minimum safe altitudes during this arrival.

The NACO program I have mentioned previously provides all the SIDs and STARs for the USA in an easily displayed format. It is a stand-alone program that can be run alongside the flight simulator (on a second monitor for example) just like having the charts handy on a pilot kneeboard. I highly recommend it.

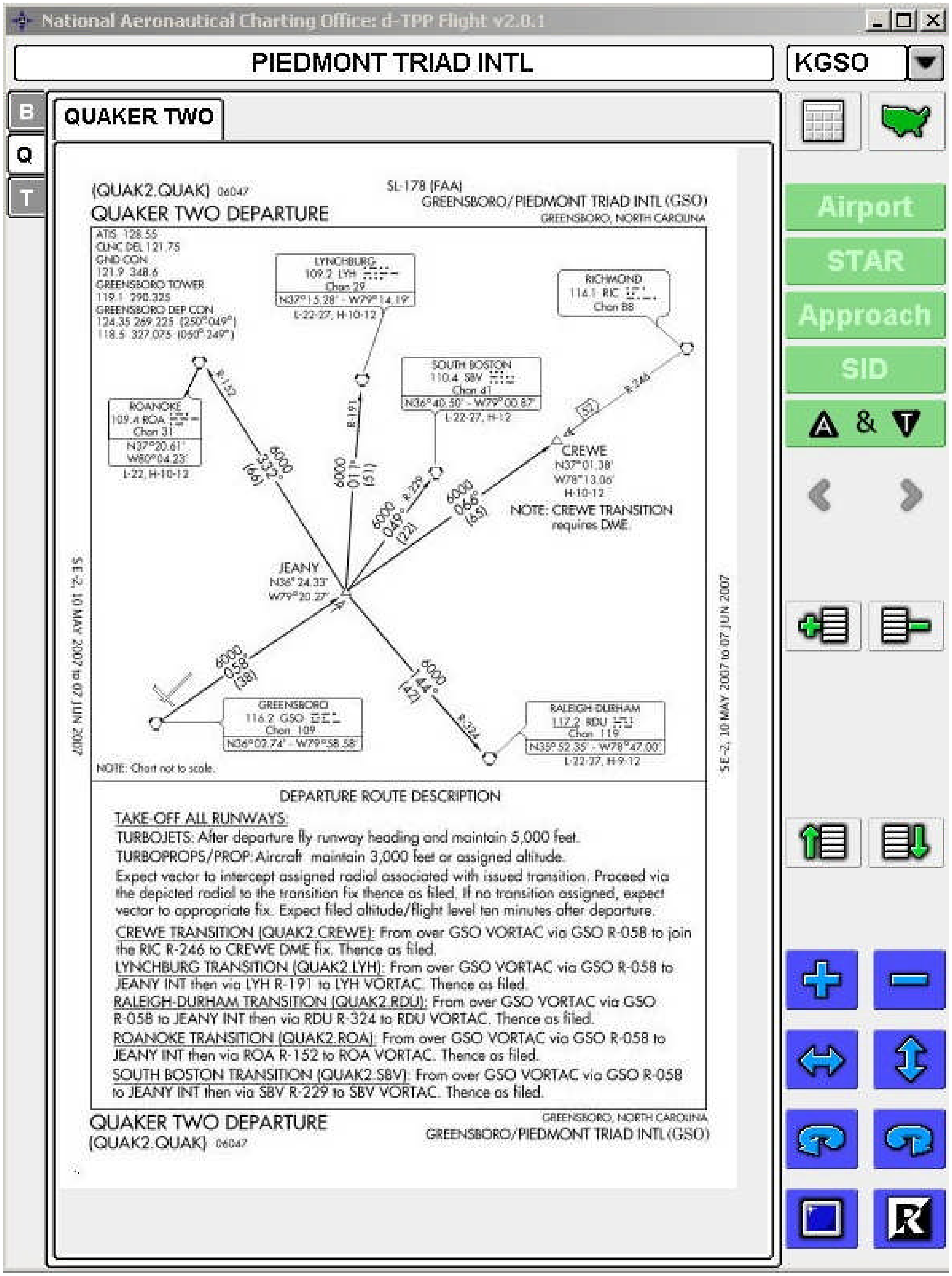


Figure 464 - The QUAKER TWO DEPARTURE (KGSO) as shown in the NACO program.

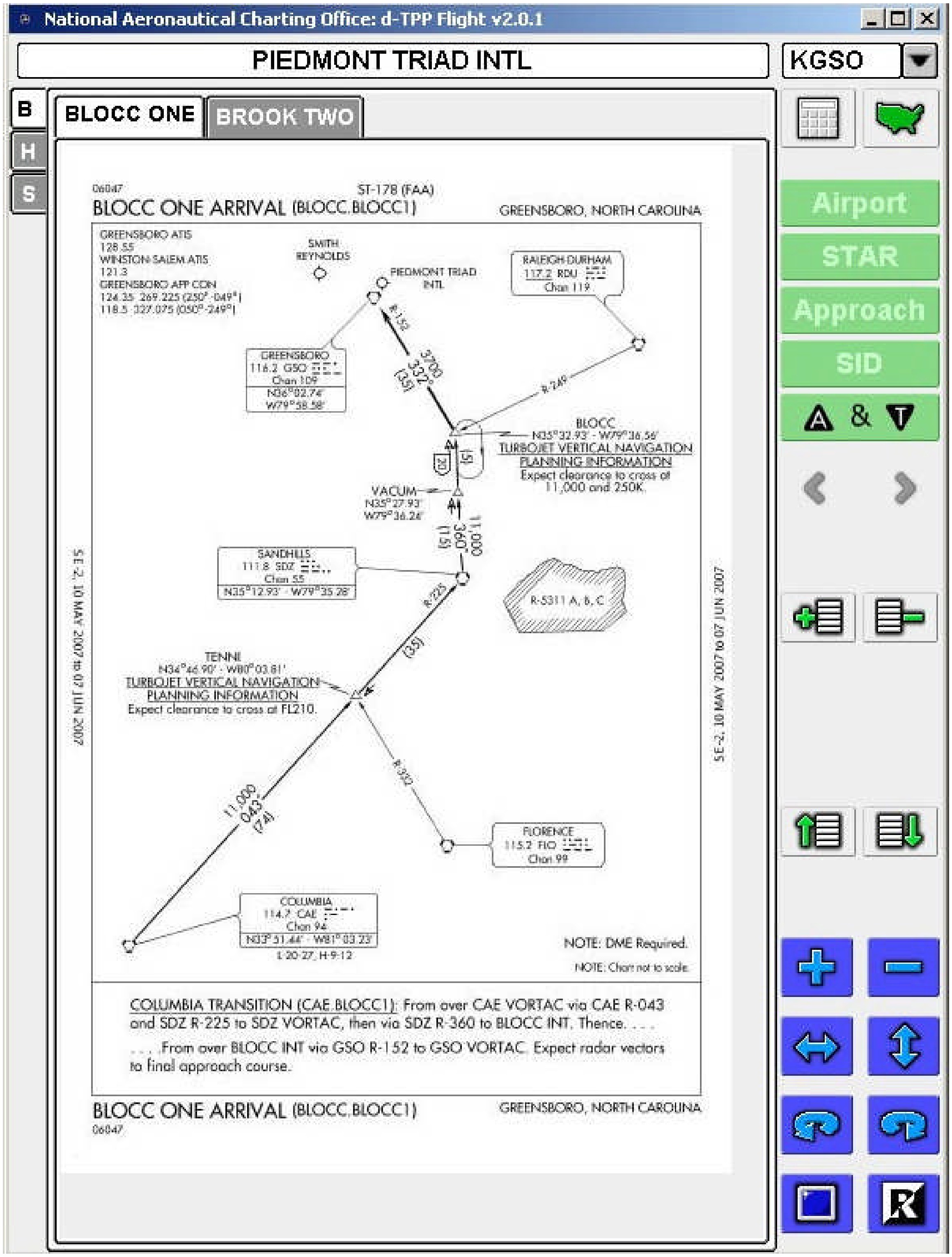


Figure 465 - The BLOCC ONE ARRIVAL (KGSO) as shown in the NACO program.

The really nice thing about this program (from the pilot perspective) is that you can switch to what you need in just a few clicks. As a matter-of-fact, once the chart you need has been pulled up you only need to click the appropriate button (STAR, APPROACH, SID) on the right side to get it to display again. So you can have everything ready to go and reference with a single click.

Always remember that the key information to look for on the SID and STAR, just like on an approach chart, are prescribed altitudes (or minimum safe altitudes), and information that relates to the NAVAIDs that help you get from one fix to the next including identification of intermediate fixes. Many of these will involve VOR transmitters so understanding how to identify, intercept, and track VOR radials are a must! If you are weak on this point go back to chapter 3 "Navigation by VOR" and brush up on these skills.

Since FS Navigator is a primary tool for the controller I want to take the time to show something that some may have not been exposed to.

If FS Navigator has a database loaded with the SIDs and STARs then the controller can use this to see a departure route or arrival. To get these to display there are some steps so follow along with me here.

First bring up FS Navigator in the simulator. You'll see a screen similar to figure 466.

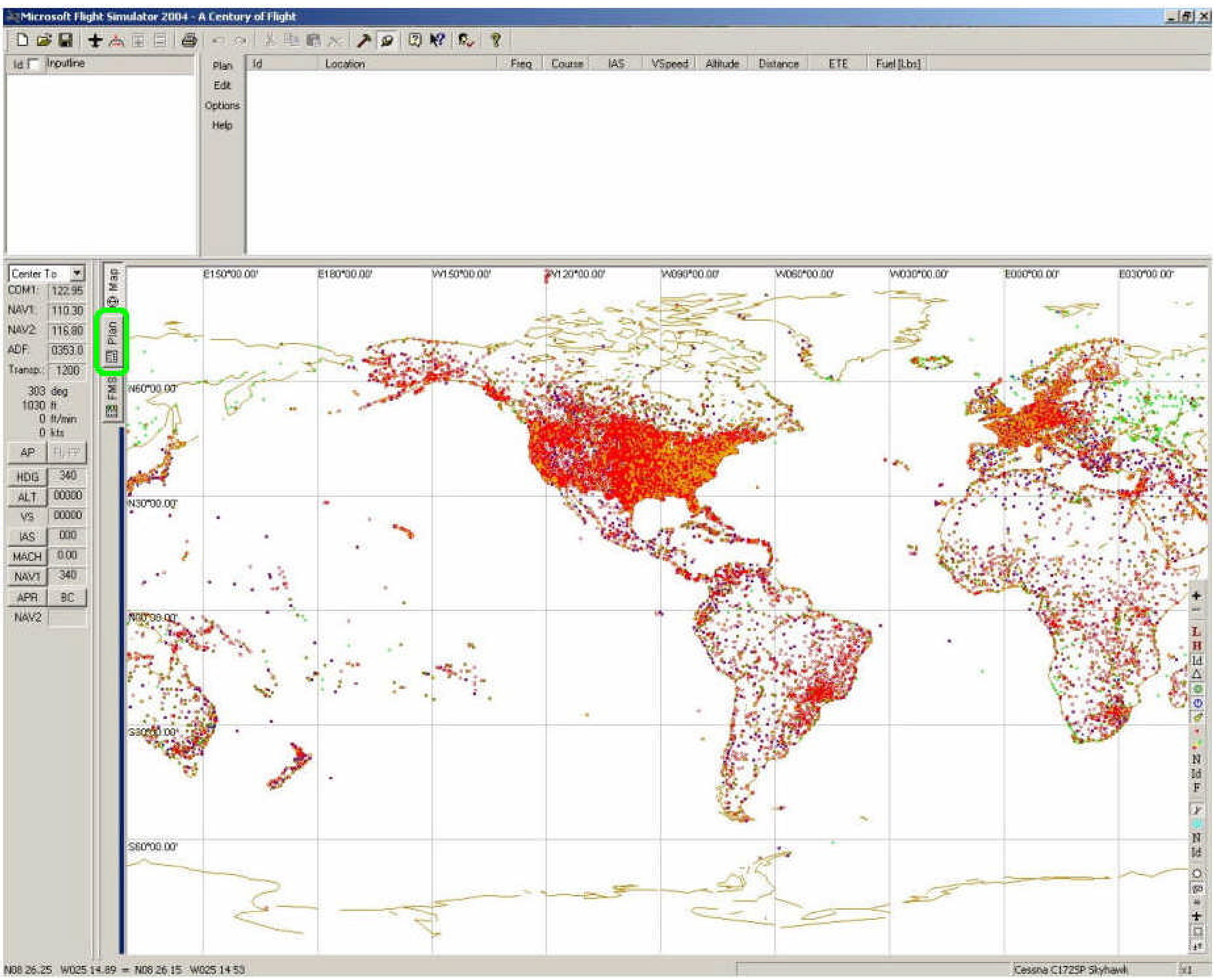


Figure 466 - FS Navigator default view.

Click on the PLAN view button circled in green in figure 466. The next screen you'll see is similar to figure 467.

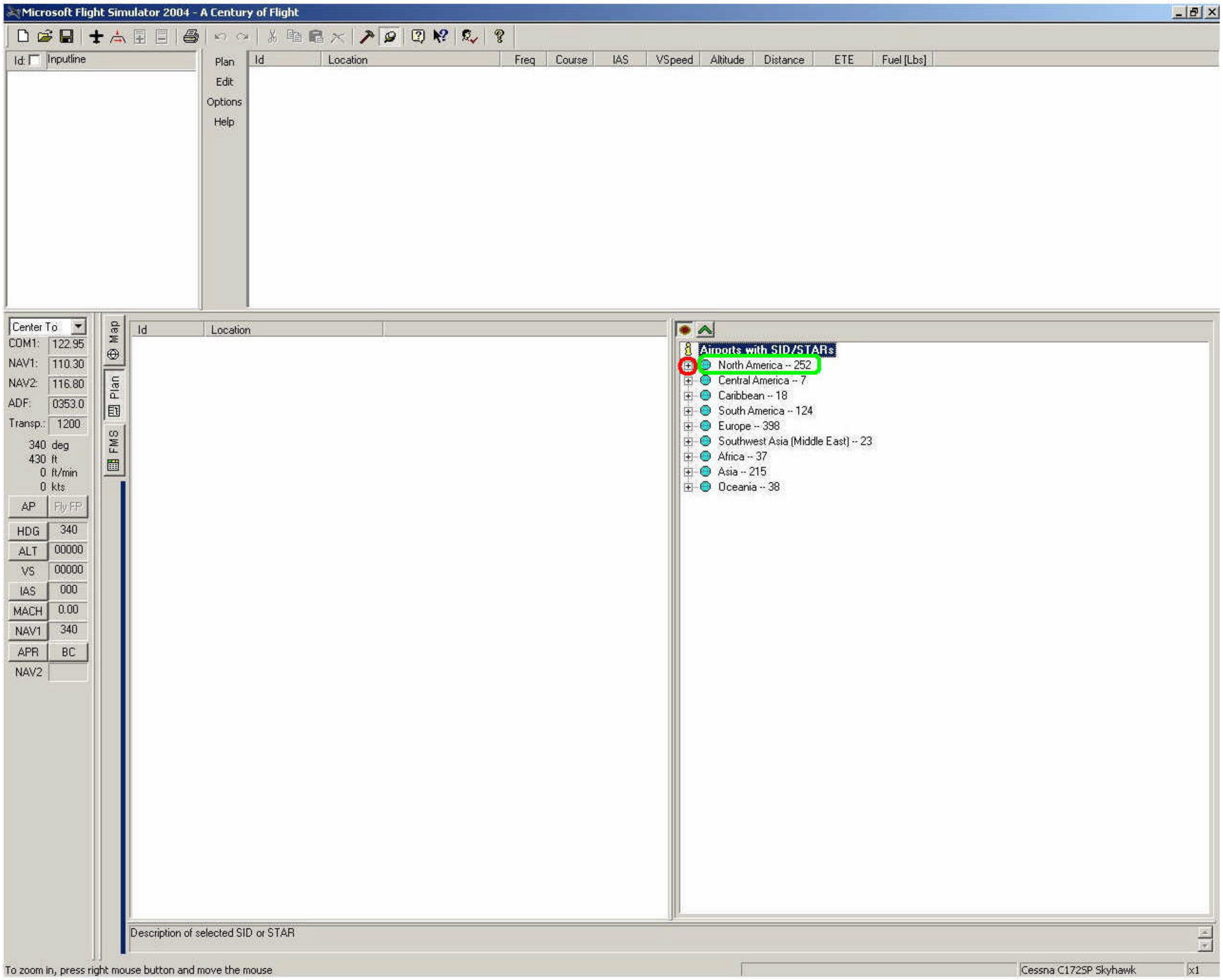


Figure 467 - SIDs and STARs list for each continent.

Notice that there are 252 SIDs and STARs listed for North America (circled in green). Click on the + symbol (circled in red) to expand the North America list (reference figure 468). You'll see that out of the 252 listed for North America 154 of these are for the United States.

Figure 468 - SIDs and STARs for the USA.

Once again click on the + symbol circled in red in figure 468 to expand the list for the United States. This will allow you to scroll through the entire database of airports that have SIDs and STARs for the United States. Scroll down the list until you find the ICAO for Greensboro NC (KGSO). When you find it click on the + symbol to expand it. You'll see a screen similar to that in figure 469. Runways listed have either SIDs or STARs published for the airport being viewed (in this case KGSO).

Now the next step is to view a SID or STAR to be used. I'll use the SID and STAR that I showed you in figures 464 and 465 for the NACO program (the SID was the QUAKER TWO DEPARTURE to Lynchburg VA and the STAR was the BLOCC ONE ARRIVAL from Columbia SC).

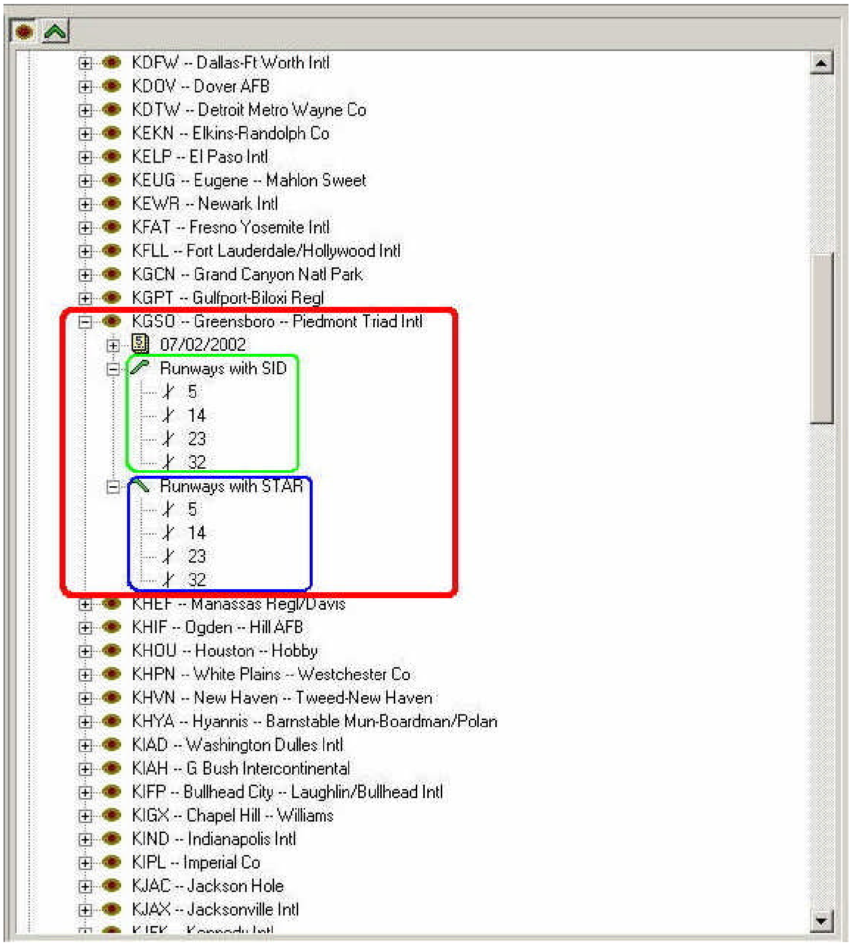


Figure 469 - Runways that have SIDs and STARs published for KGSO.

Typically there would be a flight plan loaded into FS Navigator (remember that FS Navigator was originally designed as a flight planning tool for pilots and not a tool for ATC controllers). So to display a SID or STAR you must have an airport selected and loaded into the flight plan window. This is easily done by checking the "id" block in the upper left-hand side of the screen (circled in red in figure 470) next to the input line. This tells FS Navigator that you will be entering an "identifier" or ICAO into the line.

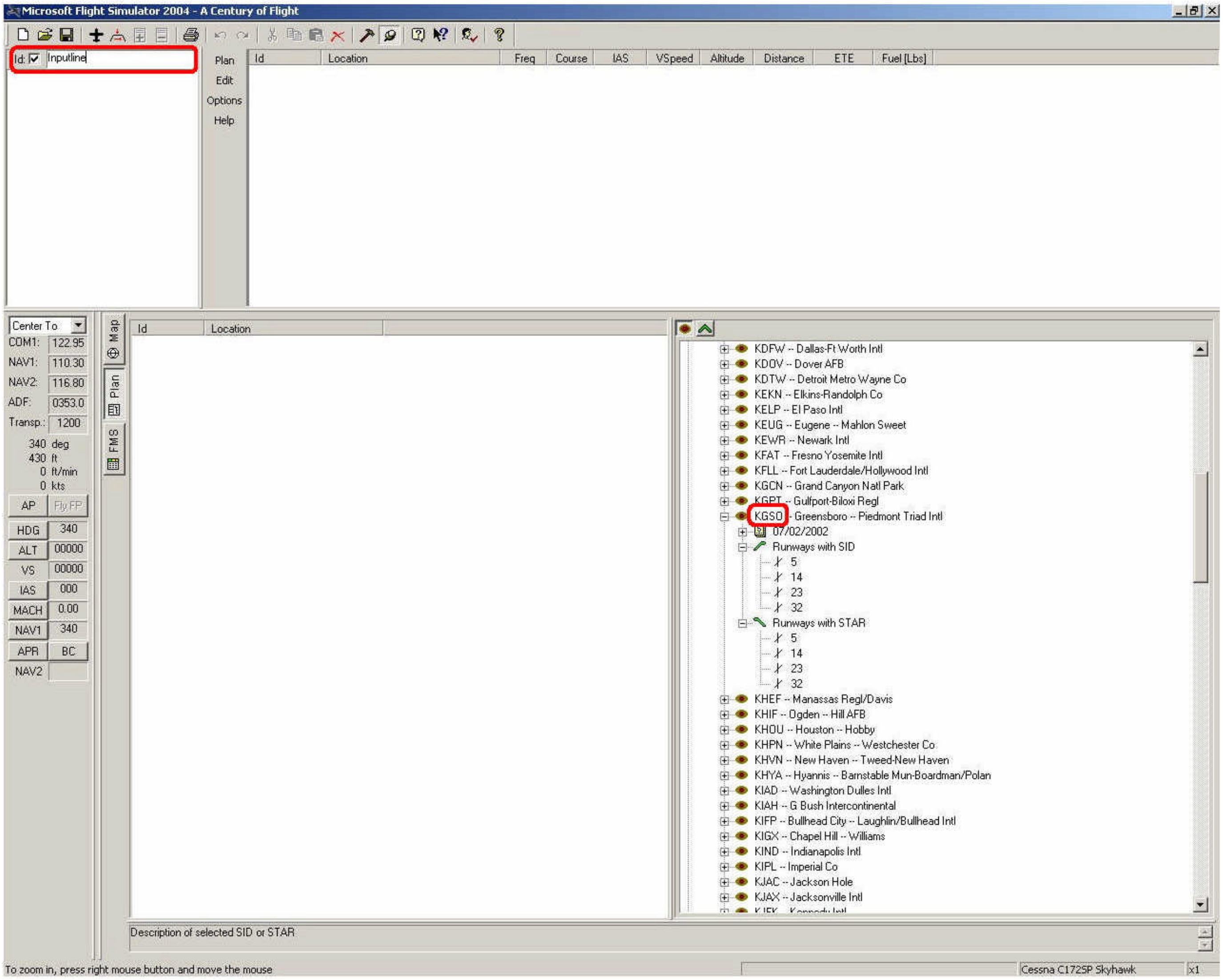


Figure 470 - Loading an airport into the FS Navigator flight plan window.

The ICAO for Greensboro NC is as listed (KGSO), also circled in red in figure 470, and is entered into the input line. Once entered press ENTER on your keyboard to tell FS Navigator to find the airport in the database.

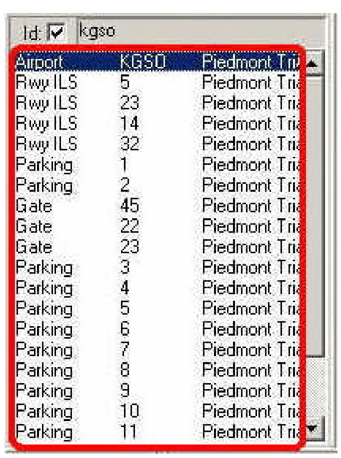


Figure 471 - Information for the KGSO airport.

Now point the mouse cursor at the airport ICAO (the first line listed in figure 471) and drag and drop it into the flight plan window (circled in red) as seen in figure 472.

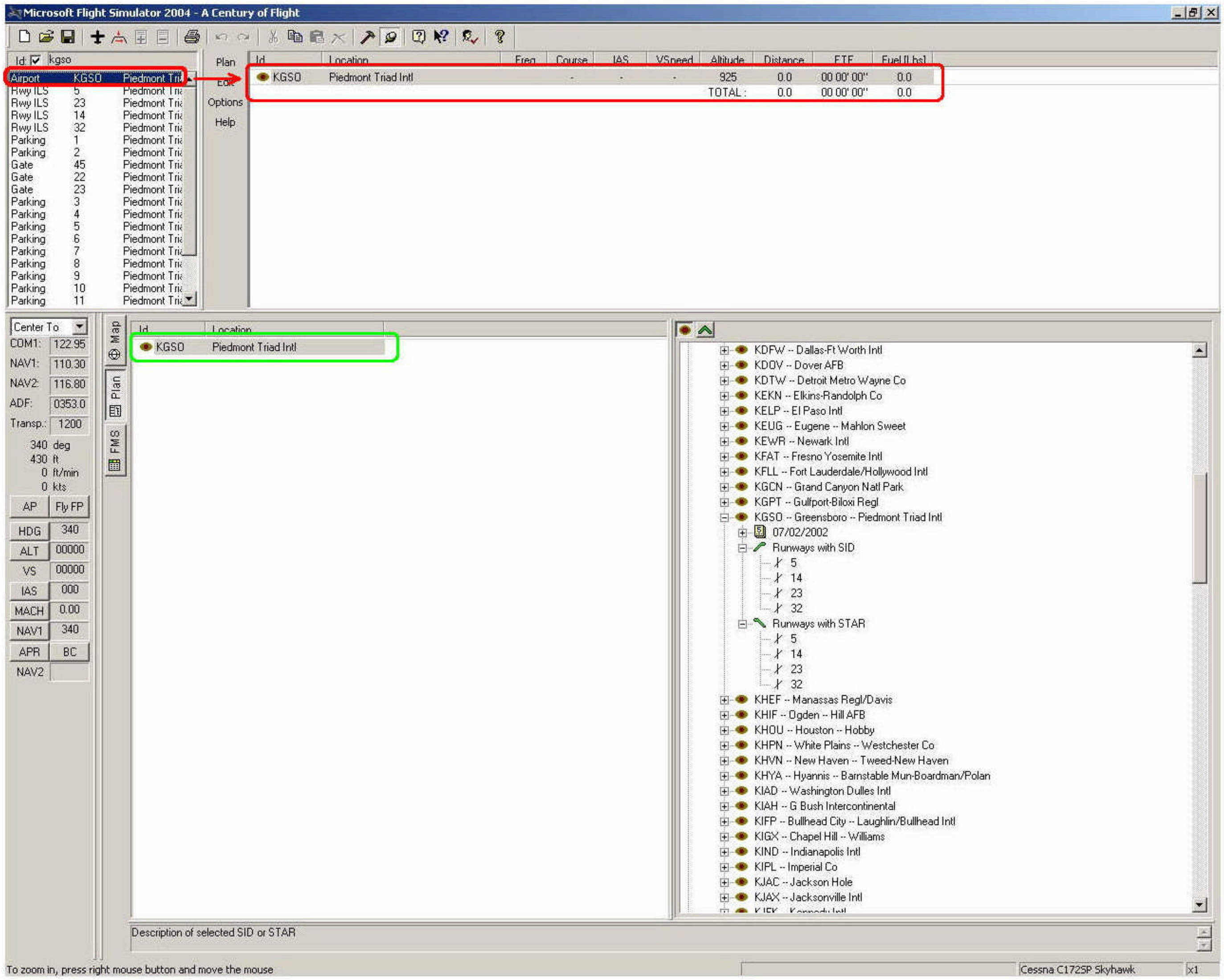


Figure 472 - KGSO loaded into the flight plan window.

KGSO will now show up in the window just to the left of the SIDs and STARs list (circled in green in figure 472). Now we are prepared to load the SID for KGSO but before we can do this we need to find the exact SID we are looking for. To do this you need to click on the arrow next to the airport symbol just above the SIDs and STARs list as seen circled in red in figure 473. This will show the list of SIDs and STARs for the KGSO airport seen in figure 473.

Now let me point out a special feature of FS Navigator concerning the SIDs and STARs. I wish the people at NACO would take a hint and use a similar feature in their program. What an intuitive feature this is when it comes to quickly identifying the correct SID or STAR depending on the departure or arrival route. Notice the circle with the "tick" mark in it (circled in blue) in figure 473. If you imagine the center of the circle is the airport location and follow the tick mark, the tick mark is showing you the general direction that the SID or STAR either departs to or arrives from. So if you were not familiar with the area but you know the general direction you are either departing to or arriving from then look at the tick mark to find an appropriate SID or STAR. Very handy indeed!

Since we are looking for the departure to Lynchburg VA click on the + symbol next to LYH (or Lynchburg).

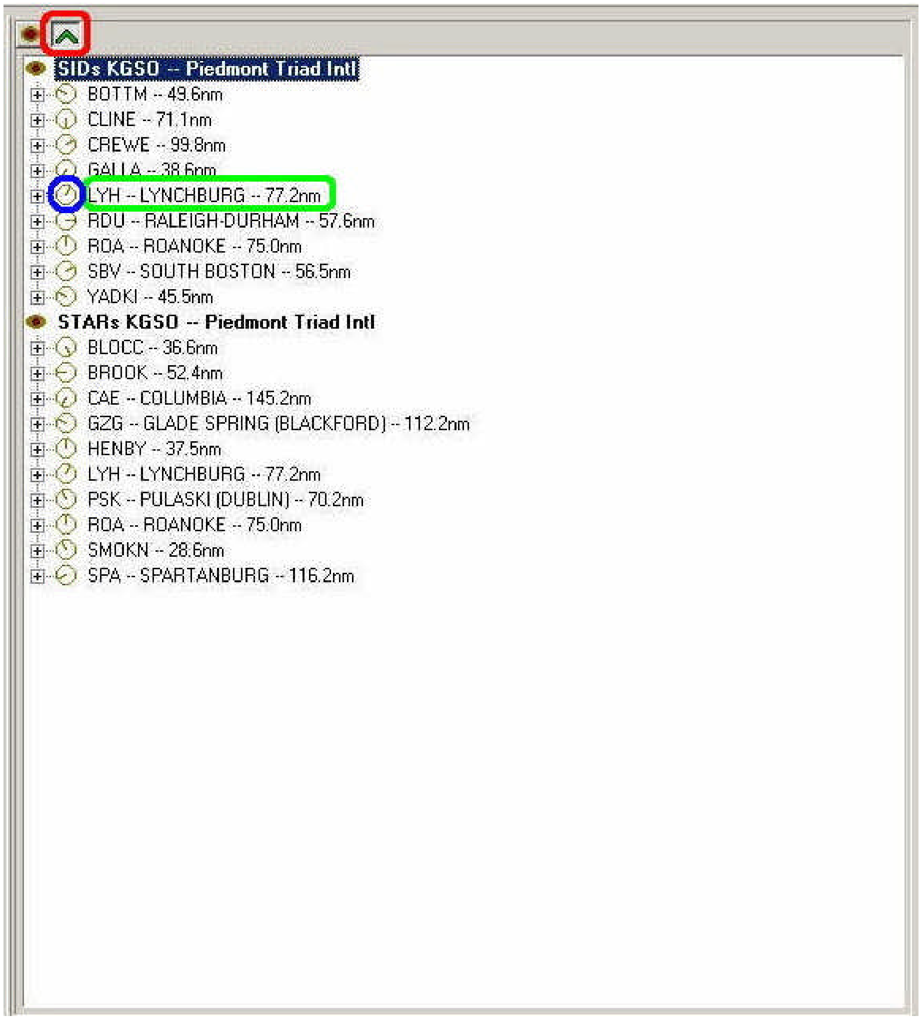


Figure 473 - Finding and selecting the SID.

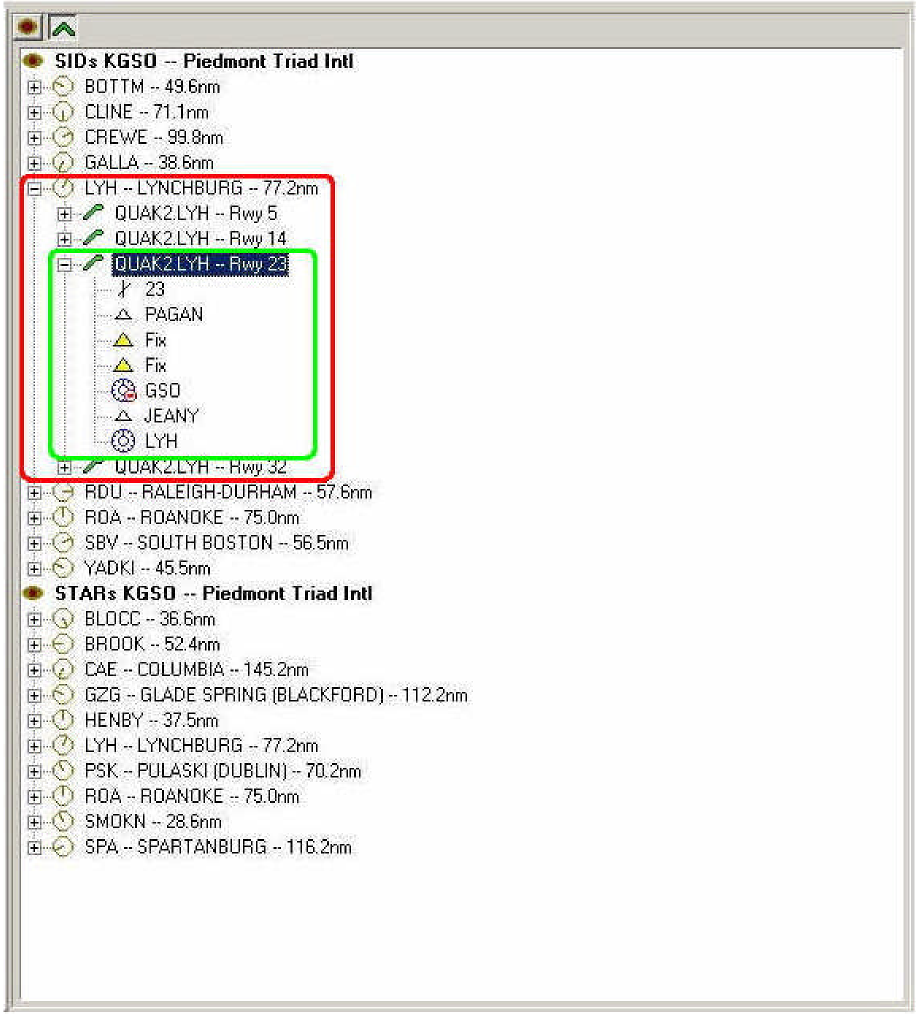


Figure 474 – The QUAKER2 DEPARTURE to Lynchburg.

Now that we have found the proper SID we wish to see (or use) click on the title QUAK2LYH – Rwy 23 and drag and drop it onto the KGSO listing in the window to the left, reference figure 475. When you do this the SID will be loaded into the flight plan for KGSO. You'll see all the fixes listed, a green vertical bar (circled in blue in figure 475) indicates the fixes that are part of the SID. Note that if you make a mistake and need to load another SID, just select the proper SID and drag and drop it again. The new one will replace the current one.

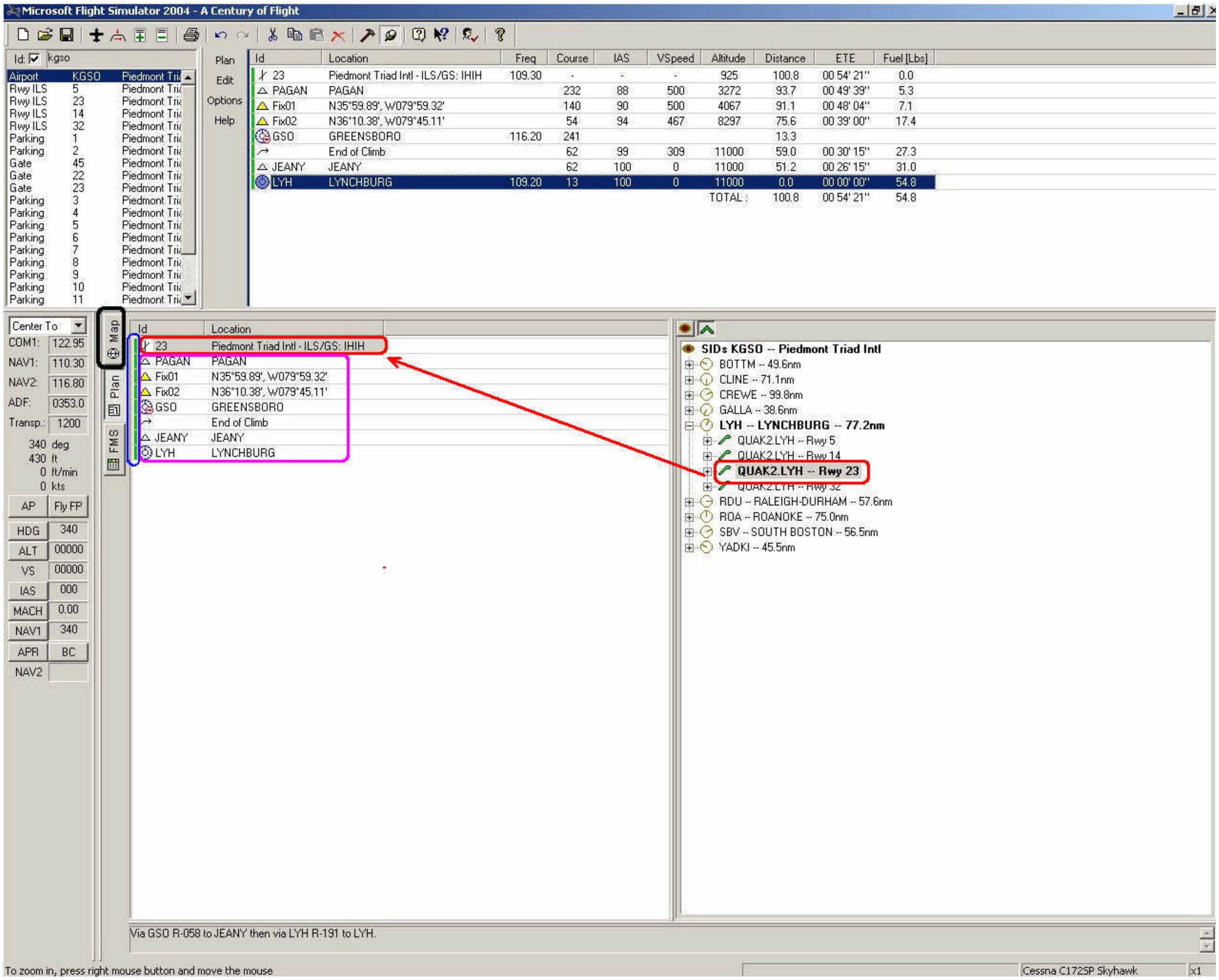


Figure 475 - Loading the SID into the flight plan.

Now once the SID is loaded for the airport the next step is to see it on the map. Easy enough, click on the MAP button (circled in black in figure 475) to see the view in figure 476.

To see all the fixes in the SID you need to turn on some map features. This is done by going to the feature icons for the map. In figure 476 they are located on the lower right side. Notice the features circled in magenta. The small "triangle" represents fixes and the second "id" button is to turn on the id's for the fixes.

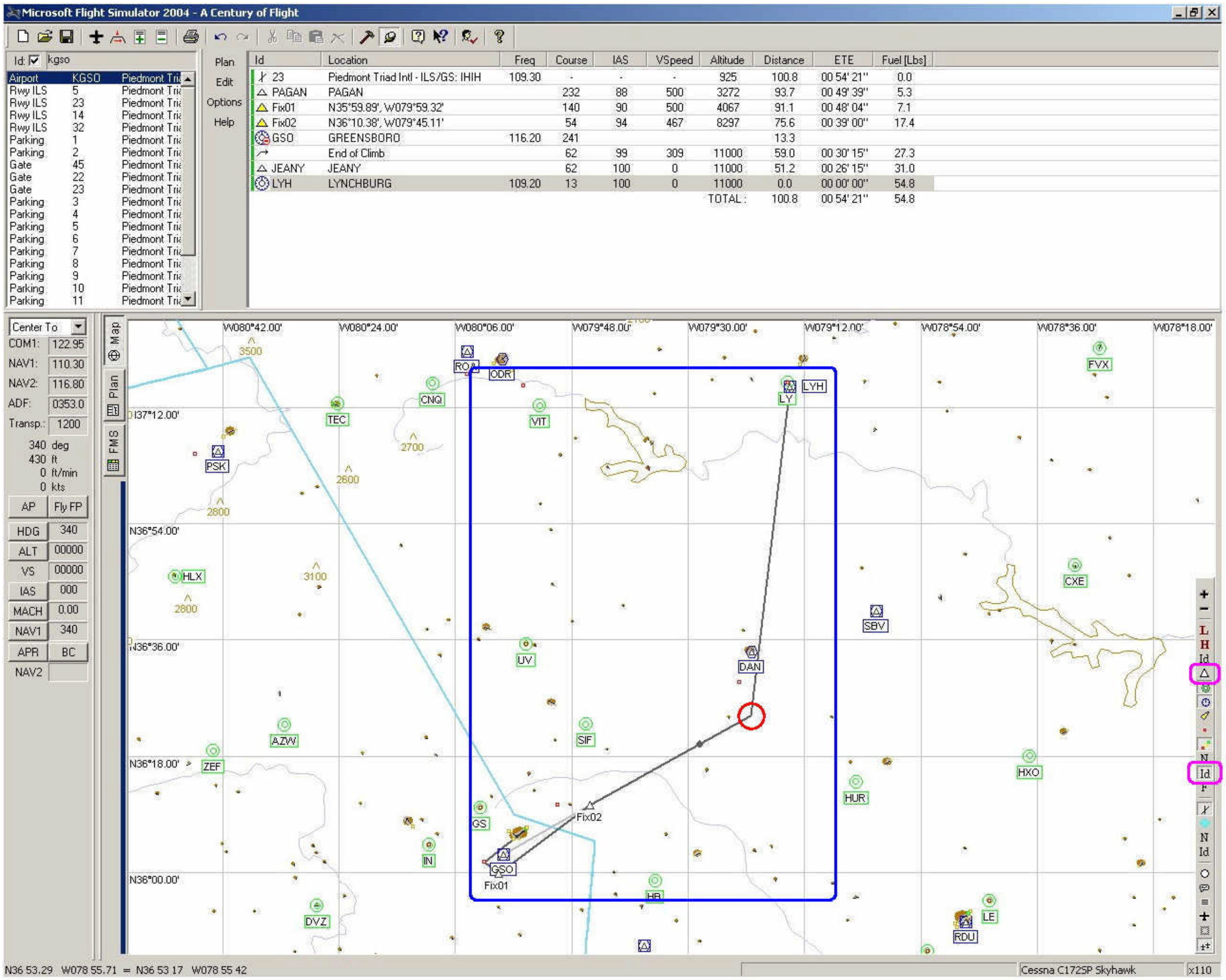


Figure 476 - The QUAKER TWO DEPARTURE to Lynchburg shown on the FS Navigator map.

When these are activated (they are toggle switches meaning they are either on or off) the fixes will be displayed on the map with their ICAO id's (reference figure 477). This will allow you to see the intermediate fix JEANY not seen in figure 476.

Of course once the aircraft reaches the LYH (Lynchburg fix), the last fix in the SID the pilot continues to the nearest fix along the en route airway of choice. If a controller is using this to track a pilot then after the last point the SID can be erased to use the map for other purposes.

Figure 477 - FS Navigator map with all fixes displayed.

Let me point out that not all SIDs or STARs are spot on (accurate) compared to the real-world charts. The SIDs and STARs data is created from users in the flight simulator community so many are flawed or the data used to create them are out-of-date. In this particular SID the GSO VOR is the first fix according to the current NACO chart, but in figure 478 you can see the creator of the SID made the outer marker the first point in the SID making use of a user input fix (Fix01) that actually circles around the GSO VOR. After making the turn the aircraft is brought back to the actual route at another user input fix (Fix02) to continue on to the intersection JEANY. This is workable for online ATC purposes so no complaints here. If you want the SID (or a STAR) to be spot on you can correct this yourself if you like, but is beyond our scope here.

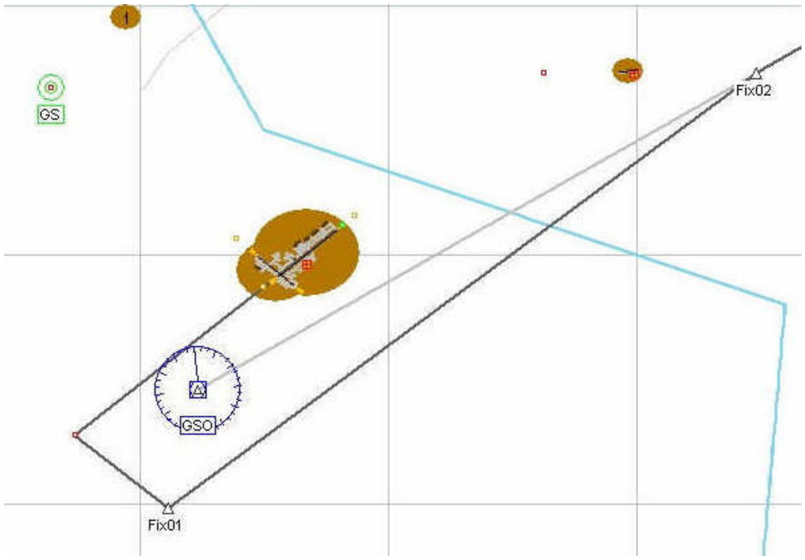


Figure 478 - Close-up of the departure from runway 23 at KGSO during the QUAKER TWO DEPARTURE.

Now let's take a look at the BLOCC ONE STAR into KGSO using FS Navigator. The process is exactly the same as described above for the SID. First clear the flight plan and map by clicking on the "new flight plan" button (icon) in the very upper left corner of the program circled in red in figure 479.

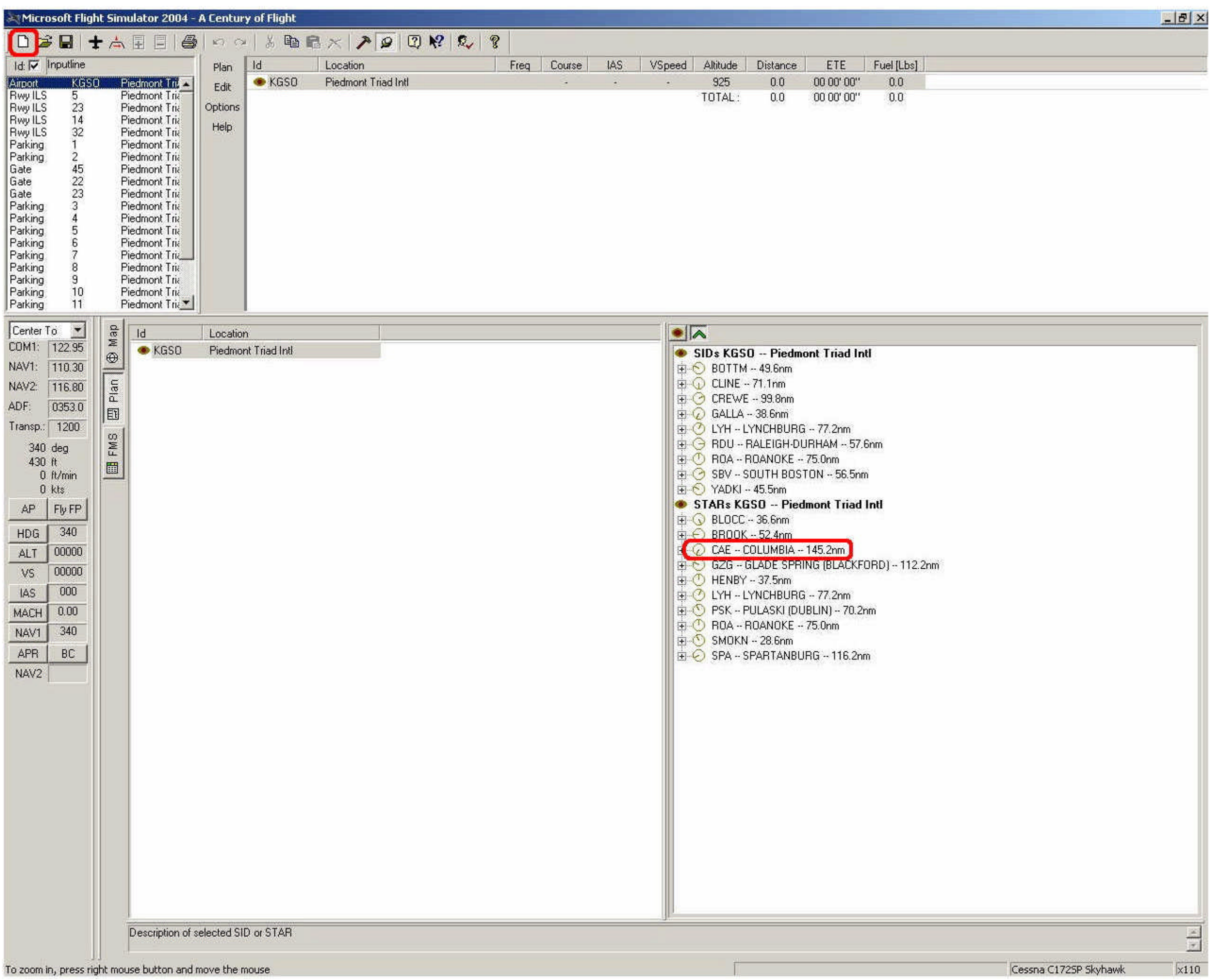


Figure 479 - Loading the STAR into the flight plan window.

Make sure that the KGSO airport is still listed in the flight plan window. Now find the Columbia transition indicated by the listing CAE – Columbia (also circled in red in figure 479). Do not use the BLOCC transition that is only a partial map of the BLOCC transition. Take note of the small circle with the tick mark again, in this case it shows the STAR arriving at Greensboro NC (KGSO) from the south (makes sense because Columbia is south of Greensboro NC). Click on the + symbol next to this listing to expand it. You'll see a listing similar to figure 480.

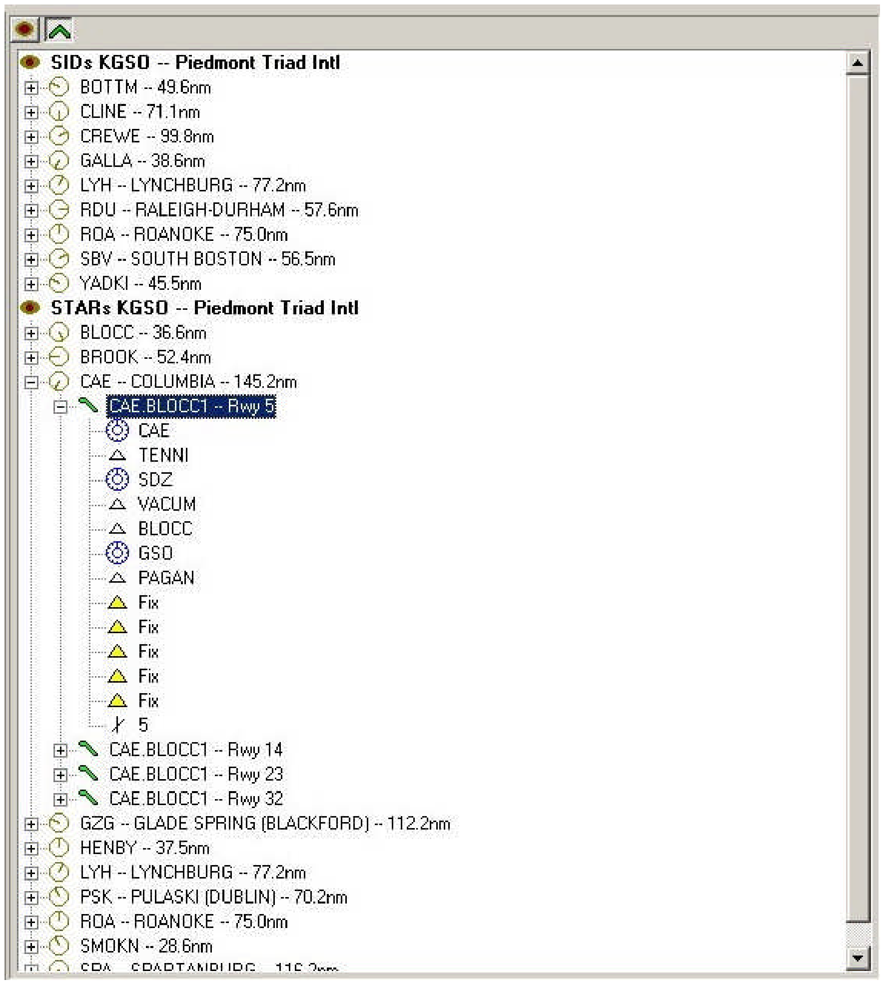


Figure 480 - The CAE.BLOCC1 - Rwy 5 Arrival.

Drag and drop the CAE transition onto the KGSO listed in the window to the left like you did for the SID. This will add the STAR to the flight plan window as seen in figure 481.

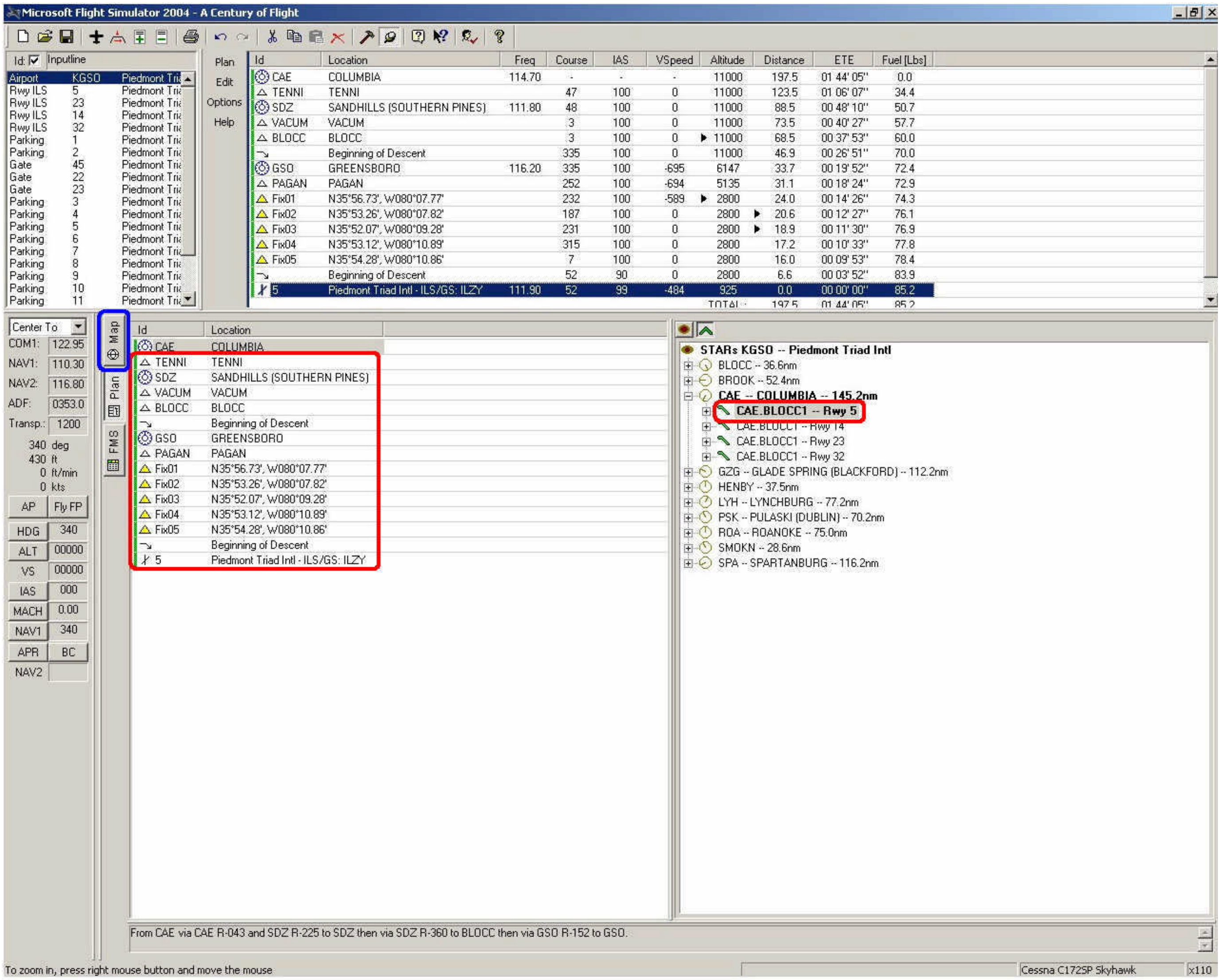


Figure 481 - The CAE BLOCC1 Arrival loaded into the flight plan window.

Now all you need to do is click on the MAP button (circled in blue) to display the FS Navigator map window.

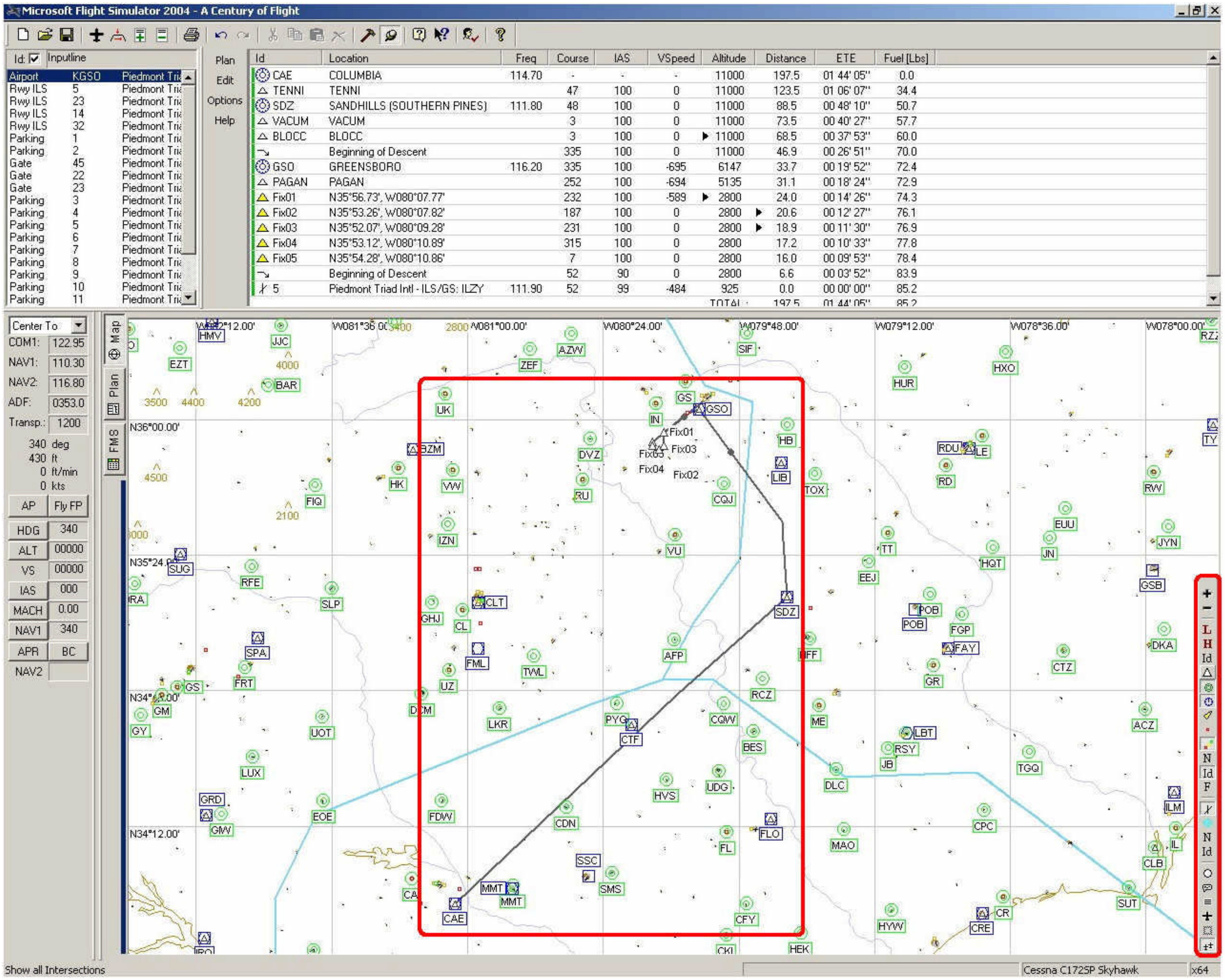


Figure 482 - The BLOCC1 Columbia arrival shown on the FS Navigator map.

Again you can use the feature icons to adjust the map display so you can see other fixes and their identifications.

The STAR shown here depicts a full approach using a procedure turn for runway 5. Real-world STAR charts do ***NOT*** include approach information. Again this is incorrectly entered when compared to an actual STAR chart. The STAR for this transition terminates at the GSO VOR but the GSO VOR in this case *is* the initial approach fix for various approaches at KGSO. Each pilot should understand that the online approach controller may or may not use the full approach so it is better to be prepared to override this procedure turn if using FS Navigator as a guidance source. The online controller may opt for a vectors-to-final approach.

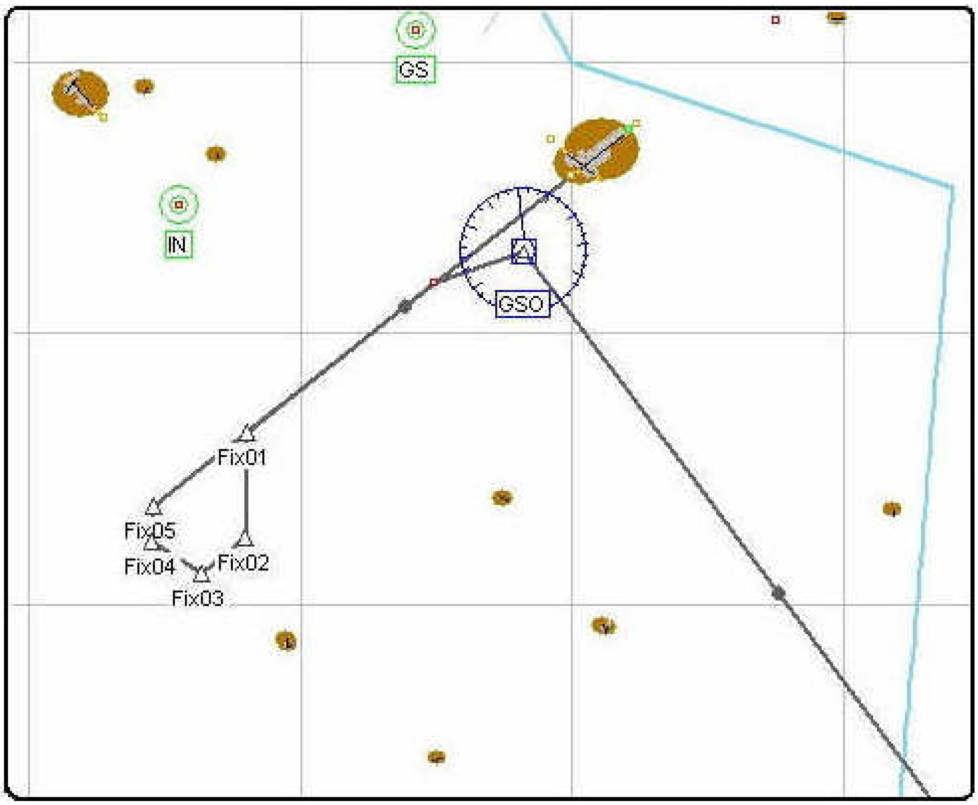


Figure 483 - A procedure turn attached to the STAR in the FS Navigator arrival.

Look at the actual VOR RWY 5 approach chart for KGSO in figure 484. The GSO VOR is the IAF for this full approach to runway 5. Remember, the full approach typically includes completing a procedure turn for the approach.

The procedure turn shown in the FS Navigator STAR is again workable in this case but be sure you understand what is proper and what has been “fudged” to make things slightly easier for the simulated pilot. Real-life pilots will understand this difference and may elect to play it up more realistically. My point here is to make things clear to the non real-life pilot type concerning what is accurate.

Also, remember that I made a point in the beginning of understanding what is presented from a pilot or controllers perspective. Some things explained here are for the pilot, controller, or both. The information about a SID and STAR is shared between both pilot and controller alike during online ATC activities.

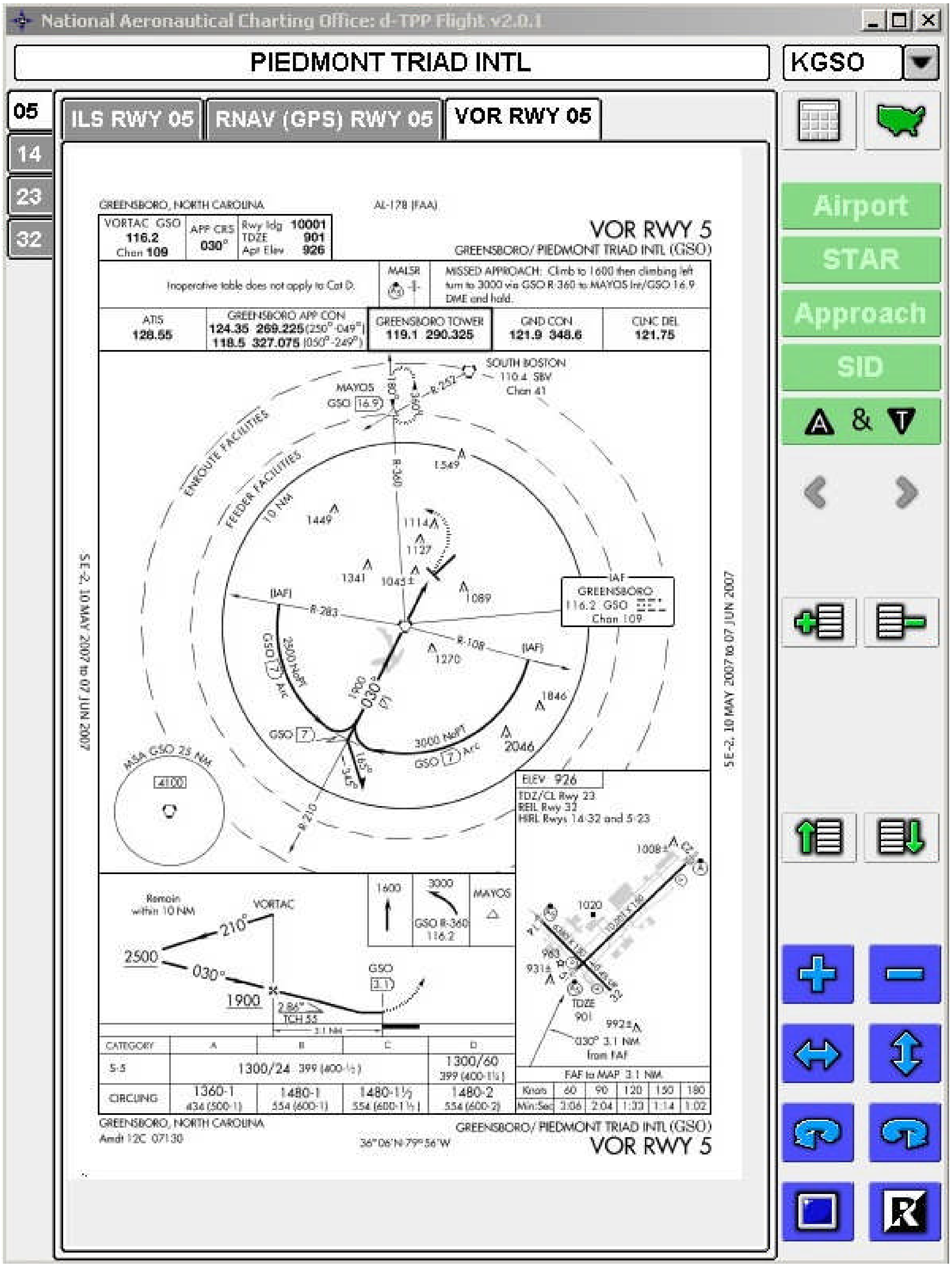


Figure 484 - The KGSO VOR RWY 5 approach chart.

So, you should have a better understanding about a SID and a STAR. They are nothing but a standardized transition from the departure airport to the en route segment of a flight or from the en route segment of the flight to the initial approach segment into the destination airport. Not all airports have SIDs or STARs. They are more typical at major congested airports to facilitate safe and efficient flow of aircraft. A simulator pilot loads the appropriate SID or STAR into either a GPS or FMC to provide guidance information to the autopilot when properly coupled. They can be hand flown but why when the autopilot can help the pilot with the burden. The controller can load a SID or STAR into FS Navigator (the controller's scope) to aid in tracking aircraft either departing or arriving at an airport (although this will be cumbersome when the controller has many aircraft to track). If a pilot is using FS Navigator for flight planning this same information provided to the controller above, to load a SID and/or STAR, will aid the pilot in loading a SID or STAR into their flight plan if using FS Navigator.

The ATC service you use will dictate the use of SIDs and STARs. They can be a unique challenge for both pilot and controller and usually require each to be skilled in reading SID and STAR charts and when and where to issue/receive clearances. *This is an important point!*

Using our examples just explained look at this scenario during an online activity, a pilot is arriving en route into KGSO. The aircraft has not yet reached the Columbia VOR (the first fix in the STAR). Again, the STAR may have been filed as part of the flight plan in advance (typically the case during an online ATC activity because most pilots load them before departure). If that is the case then the pilot, *if properly cleared* will proceed past the first fix (the CAE VOR) along the route published for the STAR.

If the pilot has properly filed the online flight plan via FSHost then the controller should be aware of the pilot's intentions to use the STAR. This is important so the controller will know to avoid issuing vectors to the pilot during the arrival. If the STAR was not part of the filed flight plan then the controller will need to issue a clearance for the STAR before reaching the initial fix entering the STAR. Why is it required to issue a clearance for the STAR? Once the pilot enters the STAR the pilot (or FMC) will control the descent (the vertical navigation portion). The pilot will either follow the altitudes published on the STAR chart or use the FMC to provide vertical guidance via the information provided in the FMC database. This is no different then clearing the pilot for an approach to landing. Once cleared *the pilot becomes responsible for controlling the aircraft's lateral* ***AND*** *vertical guidance for either a STAR or instrument landing* but until the controller issues the clearance *the pilot is not yet released to conduct the STAR (or an instrument approach) on their own, but obligated to follow instructions issued by the controller*.

Just before the STAR is completed the controller will need to provide a final clearance for the pilot to conduct the approach to be used (in this case it would be the VOR approach to RWY 5) typically a full approach. A vectors-to-final approach could be conducted after the STAR is completed but normally an approach appropriate for the STAR is used and conducted by the pilot. It could be an approach with no procedure turn (this might be the case when the STAR allows a normal intercept of the approach from an IAF where no procedure turn is required) or per controller instructions. So the controller (in our case here) would clear the pilot for the FULL VOR approach to runway 5 before reaching the IAF at GSO VOR. If the clearance is not issued in time then this can upset the applecart as the pilot will most likely be prepared to make the outbound turn for the procedure turn immediately crossing the GSO VOR. If this doesn't happen then things will become problematic for pilot and controller and the pilot might get upset because the end of a perfect flight got spoiled.

So SIDs and STARs require skills form both the pilot and controller perspective. It is also the reason for pilot's to include additional information for online activities (when compared to filing a flight plan in real-life) as described back in chapter 3. If the pilot doesn't provide this information then the online controller may not be aware of the pilot's intentions to use a STAR (or SID) causing problems with issuing proper clearances to conduct them.

Bottom line, if you're a pilot learn what to expect from the controller, if you're a controller learn what to expect from the pilot. This means you need to understand each others jobs somewhat. Controllers need to be the pilot occasionally using a SID and STAR letting other controllers issue clearances. If you're a pilot talk to online controllers about what happens behind the scenes while conducting such procedures. In the end everyone can enjoy a better online ATC experience and others will hear and learn from it.

HOLDING PATTERNS

What is a holding pattern? Well, it is obvious if you're not flying a helicopter it is "almost" impossible to park an aircraft in mid-air (not including a VSTOL aircraft <grin>). So there must be a way to delay aircraft en route for many reasons. It may be weather related, air traffic related, mechanically related, clearance related, and more, but basically a fix is chosen and the aircraft starts going in circles until the problem passes and the flight can continue. Holding patterns can also be used to properly establish an aircraft on an approach for landing.

Another aspect of the holding pattern is to provide "protected airspace" for the aircraft to fly within without danger of traffic conflict. The pilot must not only maintain the proper pattern but also the assigned altitude to stay well within the holding pattern area (or protected airspace).

Of course just going in circles is not all there is to a holding pattern, alas nothing is that simple. There are rules and criteria for entering and conducting holding patterns. Criteria for holding patterns may be found on en route charts or on approach charts. This criterion will include whether the holding pattern is a standard or non-standard pattern, the fix for the holding pattern, the length of the holding legs, and the altitude to maintain within the holding pattern. A controller may issue criteria for a holding pattern.

The holding pattern consists of an outbound and inbound leg, the fix end and the outbound end, and of course the fix that the holding pattern is established on. The bearing of the outbound side determines the holding side from the fix (I'll describe this further shortly). Which ever is the case the pilot needs to understand some basic concepts for holding patterns so let's get started. Take a look at figure 485.

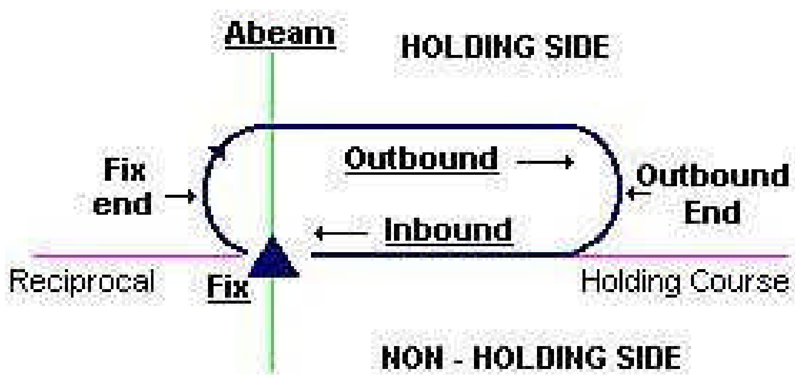


Figure 485 - The standard holding pattern.

The holding pattern in figure 485 is a right-handed holding pattern (standard pattern). If the holding pattern is left-handed it is a non-standard holding pattern. The legs of the holding pattern are typically about 1 minute in length for high speed aircraft. If the aircraft is a slower aircraft such as a Cessna then a 2 minute pattern would be more typical.

One of the most confusing concepts about holding patterns is how to enter the pattern efficiently. There are basic rules-of-thumb that can help with this. Take a look at figure 486.

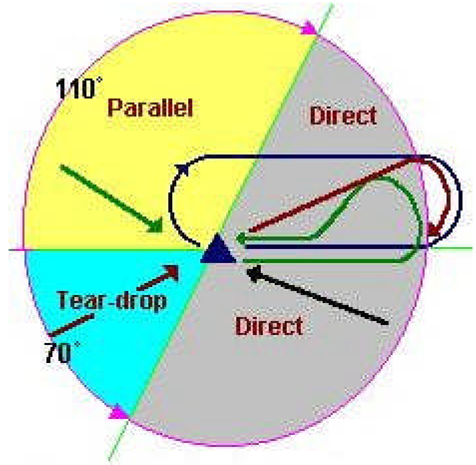


Figure 486 - Determining entry into a holding pattern.

If the aircraft approaches the holding fix from anywhere within the sector labeled "Direct" (gray in color) then the aircraft can enter the holding pattern directly. Basically once crossing the fix the pilot starts a right turn to the outbound heading. Again depending on the aircraft speed maintain the outbound heading for either 1 minute (for prop aircraft) or for 2 minutes (for jet aircraft). Then a 180° turn is completed to roll out on the inbound heading headed back to the holding pattern fix. If the fix is a NAVAID then the inbound track is used to determine angles of correction for wind drift based on deviations from the inbound ground track. Apply the same correction to the outbound leg to keep the holding pattern properly "shaped".

If the aircraft approaches the holding pattern fix from within the "Tear-drop" (cyan colored) sector in figure 486 the pilot makes a tear-drop entry. After crossing the fix the pilot turns to a heading 30° less than the outbound heading for the time required (again 1 or 2 minutes). If the outbound heading were 090° then the tear-drop heading is 060° then start a right-handed turn back to the inbound heading of 270° (again if the fix is a NAVAID you would actually intercept the inbound ground track to the NAVAID, in this case the 270° bearing TO the NAVAID). Reference the brown line in figure 486.

If the aircraft approaches the holding pattern fix anywhere within the "Parallel" (yellow colored) sector in figure 486 then a parallel entry is conducted. After crossing the fix the pilot turns to the outbound heading for 1 or 2 minutes. Then a left-hand turn is made to intercept the inbound bearing (or proceed directly back to the fix (or NAVAID). Once back over the fix the pilot makes a right-hand turn to enter the holding pattern just as if entering it via the "Direct" method.

Now let me show the pilot how to visualize the *standard holding pattern entry* using the cockpit directional gyro (DG). Divide the DG into sectors as seen in figure 487. It doesn't matter which direction the aircraft is headed or how the holding pattern is oriented. Always divide the DG as seen in figure 487. No matter what heading is shown at the top of the DG imagine it to be the 360° point on a compass. Draw the green line from the 070° point down to what would be the 250° point effectively dividing the DG in half using the 360° point. This will create the "Parallel" and "Tear-drop" sectors shown in figure 487 and as seen in figure 486.

Figure 487 - How to visualize the sectors on the DG.

The holding pattern entry is based on these imaginary sectors on the DG. If the holding pattern were a non-standard holding pattern the green line would be opposite that shown in figure 487. It would be drawn from the 290° point down to the 120° point. The "Parallel" and Tear-drop" sectors would reverse sides. Let's make some examples to see how this works using a standard holding pattern.

Example #1

If the controller tells the pilot to "…hold east of the JEANY intersection at 5000 feet…" then the pilot, if approaching the JEANY intersection on the heading shown in figure 487 (150°) determines the proper entry into the pattern. Since the controller indicated the pilot is to hold east this means the *outbound heading for the holding pattern* is 090°. Looking at the DG the 090° bearing is within the "Parallel" sector. So the pilot enters the pattern using the parallel entry.

As the pilot approaches the fix the aircraft is leveled off at 5000 feet MSL as instructed. Then upon crossing the fix the pilot turns the aircraft to 090° (if the fix is a NAVAID the pilot tracks the 090° ground track outbound) for 1 or 2 minutes as appropriate then initiates a *left-hand turn* to intercept the inbound ground track (again if the fix is a NAVAID the pilot tracks the 270° inbound ground track back to the NAVAID) or proceed directly back to the fix itself. Once reaching the fix again the pilot enters the holding pattern turning to the outbound heading of 090° again and holding this heading for 1 or 2 minutes as appropriate. Then the pilot makes a 180° right-hand turn back to 270° tracking back to the holding pattern fix and thence…

Example #2

If the controller tells the pilot to "…hold south on the 180° radial of the BZM VOR at 6000 feet…" then the pilot, if approaching the BZM VOR on the heading shown in figure 487 (150°) determines the proper entry into the pattern. Since the controller indicated the pilot is to hold south on the 180° radial this means the outbound heading for the holding pattern is 180°. Looking at the DG the 180° bearing is within the "Tear-drop" sector. So the pilot enters the pattern using the tear-drop entry.

As the pilot approaches the fix the aircraft is leveled off at 6000 feet MSL. Then upon crossing the fix the pilot turns the aircraft to 150° (which is 30° less than the outbound heading of 180°) for 1 or 2 minutes as appropriate then initiates a right-hand turn to intercept the inbound ground track (again if the fix is a NAVAID the pilot tracks the 360° inbound ground track back to the NAVAID). Once reaching the fix again the pilot enters the holding pattern turning to the outbound heading of 180° again and holding this heading for 1 or 2 minutes as appropriate. Then the pilot makes a right-hand 180° turn back to 360° tracking back to the holding pattern fix and thence…

Example #3

If the controller tells the pilot to "…hold west on the 270 bearing from the TAWBA NDB at 7000 feet MSL…" then the pilot, if approaching the TAWBA NDB on the heading shown in figure 487 (150°) determines the proper entry into the pattern. Since the controller indicated the pilot is to hold west on the 270° bearing this means the outbound heading for the holding pattern is 270°. Looking at the DG the 270° bearing is within the "Direct" sector. So the pilot enters the pattern using the direct entry.

As the pilot approaches the fix the aircraft is leveled off at 7000 feet MSL. Then upon crossing the fix the pilot makes a right-hand turn to a heading of 270° maintaining this heading for 1 or 2 minutes as appropriate then initiates a 180° right-hand turn to intercept the inbound ground track (again if the fix is a NAVAID the pilot tracks the 090° inbound ground track back to the NAVAID). Once reaching the fix again the pilot remains in the holding pattern turning 180° to the outbound heading of 270° and thence…

Example #4

Sometimes DME may be used to determine the length of the outbound and inbound legs (much more accurate) as seen in figure 488.

If the controller tells the pilot to "…hold north of the BZM VOR using 5nm legs at 8000 feet MSL…" then the pilot, if approaching the BZM VOR on the heading shown in figure 487 (150°) determines the proper entry into the pattern. Since the controller indicated the pilot is to hold north this means the *outbound heading for the holding pattern* is 360°. Looking at the DG the 360° bearing is within the "Direct" sector. So the pilot enters the pattern using the direct entry.

As the pilot approaches the BZM VOR the aircraft is leveled off at 8000 feet MSL. Then upon crossing the VOR the pilot makes a right-hand turn to a heading of 360° maintaining this heading until the DME reads 5nm from the BZM VOR then initiates a 180° right-hand turn to intercept the inbound 180° radial back to the BZM VOR. Once reaching the VOR again the pilot remains in the holding pattern turning 180° to the outbound heading of 360° and thence…

Note that a fix doesn't have to be co-located with a NAVAID with DME capability (as depicted in figure 488). As seen in figure 488 the fix is located 10nm from the NAVAID. Since the holding pattern legs are 5nm in length this means the turn at the end of the outbound leg is started when the DME reads 15nm. The location of the fix is determined when the DME reads 10nm from the NAVAID.

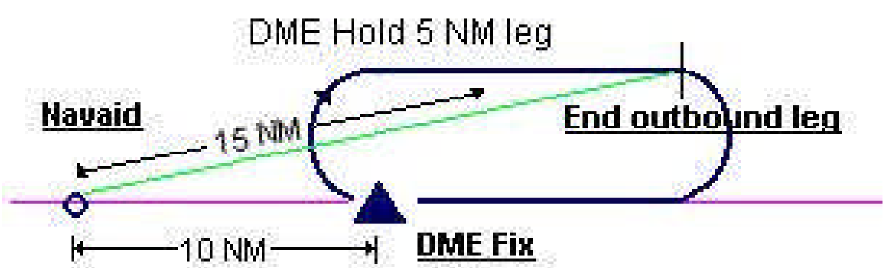


Figure 488 - Using DME to determine the holding pattern legs.

Holding patterns can be easily managed if you remember how to determine the holding pattern entry by visualizing the sectors on the DG. The leg lengths are 1 or 2 minutes based on the speed of the aircraft, as a rule-of-thumb use 1 minute for jet aircraft and 2 minutes for prop aircraft. If using DME the important thing to remember is whether the DME station is co-located at the fix, if not adjust your calculations accordingly. Don't forget that wind drift is a factor maintaining a proper holding pattern. The pilot will probably need to make corrective turns into the wind. The amount of correction required depends on the wind angle and speed. It may take a couple of laps in the holding pattern to get the correct amount of correction.

IFR GLOSSARY

ADF	Automatic Direction Finding
AGL	Above Ground Level
AI	Artificial Intelligence
APR/APP	Approach
APT	Airport
ATC	Air Traffic Control
ATIS	Automated Terminal Information Service
AWOS	Automated Weather Observation Station
BC	Back Course
CHAN	Channel
CL	Climb
COM	Communications
CR	Cruise
CRS	Course
CTAF	Common Terminal Advisory Frequency
DH	Decision Height
DME	Distance Measuring Equipment
EHSI	Electronic Horizontal Situation Indicator
FAF/"X"	Final Approach Fix
FD	Flight Director
FL	Flight Level (as in FL180 – 18000 feet)
FPM	Feet per Minute
GCA	Ground Controlled Approach
GS	Glide Slope
HDG	Heading
HIRL	High Intensity Runway Lights
HIS	Horizontal Situation Indicator
IAF	Initial Approach Fix
IAP	Instrument Approach Procedure
ID	Identifier (or Identity)
IFR	Instrument Flight Reference
IM	Inner Marker
IMC	Instrument Meteorological Conditions
INT	Intersection
LDG	Landing
LOC	Localizer
LOM	Localizer Outer Marker
MALSR	Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights
MAP	Missed Approach Point
MDA	Minimum Descent Altitude
MIRL	Medium Intensity Runway Lights
MKR	Marker
MM	Middle Marker
MSA	Minimum Safe Altitude
MSL	Mean Sea Level
NAV	Navigation
NDB	Non Directional Beacon
NM	Nautical Mile
NoPT	No Procedure Turn
NPA	Non-Precision Approach
OBS	Omni Bearing Setting

OM	Outer Marker
PAP	Precision Approach Procedure
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
R-005	Radial 005 (as in VOR radial)
RA	Radar Altimeter
REIL	Runway End Identification Lights (Strobes)
RWY	Runway
SM	Statute Miles
TCH	Threshold Crossing Height
TDZE	Touchdown Zone Elevation
TO/GA	Take Off/Go Around
US	United States
VASI	Visual Approach Slope Indicator
VGSI	Visual Glide Slope Indicator
VMC	Visual Meteorological Conditions
VOR	Variable Omni Range
VSI	Vertical Speed Indicator

PILOT/CONTROLLER COMMUNICATIONS

CHAPTER 6

TERMINOLOGY/PHRASEOLOGY

It can not be overlooked that the flying world has language and terms unique to the operations conducted. So this section will try and review some terminology (*the lingo*) *virtual pilots and controllers* should be familiar with so as to understand each other better.

TERMINOLOGY

FLIGHT PLAN

By definition a flight plan is specified information relating to the intended flight of an aircraft that is filed orally or in writing with an FSS (Flight Service Station) or an ATC facility.

AIR TRAFFIC CLEARANCE

By definition an air traffic clearance is an authorization by air traffic control for the purpose of preventing collision between known aircraft, for an aircraft to proceed under specified traffic conditions within controlled airspace. The pilot-in-command of an aircraft may not deviate from the provisions of a visual flight rules (VFR) or instrument flight rules (IFR) air traffic clearance except in an emergency or unless an amended clearance has been obtained. Additionally, the pilot may request a different clearance from that which has been issued by air traffic control (ATC) if information available to the pilot makes another course of action more practicable or if aircraft equipment limitations or company procedures forbid compliance with the clearance issued. Pilot's may also request clarification or amendment, as appropriate, any time a clearance is not fully understood, or considered unacceptable because of safety of flight. Controllers should, in such instances and to the extent of operational practicality and safety, honor the pilot's request.

Note: FAR Part 91.3(a) states that *the pilot-in-command of an aircraft is directly responsible for, and is the final authority as to, the operation of that aircraft*. The pilot is responsible to request an amended clearance if ATC issues a clearance that would cause a pilot to deviate from a rule or regulation, or in the pilot's opinion, would place the aircraft in jeopardy.

RADAR SERVICE

By definition radar service is a term which encompasses one or more of the following services based on the use of radar which can be provided by a controller to a pilot of radar identified aircraft.

1. Radar Monitoring. The radar flight-following of aircraft, whose primary navigation is being performed by the pilot, to observe and note deviations from its authorized flight path, airway, or route.
2. Radar Navigational Guidance. Vectoring aircraft to provide course guidance.
3. Radar Separation. Radar spacing of aircraft in accordance with established minima.

RADAR CONTACT

By definition radar contact is:

1. Used by ATC to inform an aircraft that it is identified on the radar display and radar flight following will be provided until radar identification is terminated.

2. The term used to inform the pilot that the aircraft is identified and approval is granted for the aircraft to enter the receiving controller's airspace.

During online activities "Radar Contact" is used to establish "positive" control of an aircraft either IFR or VFR. During IFR flights radar contact is normally established by the departure controller shortly after takeoff and handoff by the tower. Radar contact can be a continuation of radar services in progress for aircraft inside controlled airspace or en route and typically related to a given clearance.

RADAR CONTACT LOST
By definition radar contact lost is <u>used by ATC to inform a pilot that radar data used to determine the aircraft's position is no longer being received, or is no longer reliable and radar service is no longer being provided.</u>

Loss of radar service can actually happen during online play. The host server may go down temporarily causing the controller to loose the display of online multiplayer aircraft. Communications may not necessarily be lost at the same time depending on the hardware setup. Also the opposite can happen the communications server may go down causing "lost communications" but the multiplayer host server remains up allowing controllers to "see" online multiplayer aircraft.

Radar contact lost can be a temporary or permanent condition and as defined *indicates <u>no longer provided</u> but does not necessarily mean a loss of "positive" ATC control*. The pilot will be required to adhere to any current clearance as best possible.

RADAR SERVICE TERMINATED
By definition radar service terminated is <u>used by ATC to inform a pilot that s/he will no longer be provided any of the services that could be received while in radar contact. Radar service is automatically terminated, and the pilot is NOT advised in the following cases:</u>

1. An aircraft cancels its IFR flight plan.
2. An aircraft conducting an instrument, visual, or contact approach has landed or has been instructed to change to advisory frequency.

Note that other FAR points defined are omitted here as they won't apply in our current use for online play.

Unlike the condition of radar contact lost that informs the pilot the controller can no longer "see" the aircraft and can not provide proper service, *radar service terminated during online play means that the aircraft is no longer under "positive" ATC control and radar service will not be provided any longer*. Once radar service is terminated if the pilot wishes to enter controlled airspace or receive radar service they must contact the appropriate controller per the ATC service guidelines and state their request.

FLIGHT LEVEL
By definition flight level is <u>a level of constant atmospheric pressure related to a reference datum of 29.92 inches of mercury. Each is stated in three digits that represent hundreds of feet. For example, flight level (FL) 250 represents a barometric altimeter indication of 25,000 feet; FL 255, an indication of 25,500 feet.</u>

Flight levels are a term commonly used by IFR pilots that fly commercial or corporate aircraft capable of reaching very high altitudes (to be precise 18,000 feet and above). In the U.S. all aircraft flying at or above 18,000 feet are required to use the constant atmospheric pressure reference datum of 29.92 as defined. Aircraft that fly between FL180 up to FL600 are within Class A airspace. Pilots are not allowed to cancel IFR flight plans while flying in Class A airspace.

PHRASEOLOGY

Within the Aeronautical Information Manual (AIM) there is an entire section related to radio communications, phraseology, and techniques. Things such as initial contact, acknowledgment of frequency changes, compliance of frequency changes, aircraft call signs, ground station call signs, phonetic alphabet, figures, altitude and flight levels, directions, speeds, and time are all discussed. For purposes of online activities I'll provide simple examples of things we need to practice to sound professional and polished.

When speaking figures (numbers) use the following:

1. Figures indicating hundreds and thousands in round number, as for ceiling heights, and upper wind levels up to 9,900 they shall be expressed as follows:
    a. 500 would be spoken as "five hundred"
    b. 4,500 would be spoken as "four thousand five hundred"

2. Numbers above 9,900 shall be spoken by separating the digits preceding the word "thousand" expressed as follows:
    a. 10,000 would be spoken as "one zero thousand"
    b. 13,500 would be spoken as "one three thousand five hundred"

3. All other numbers shall be transmitted by pronouncing each digit separately such as 10 "one zero".

4. When a radio frequency contains a decimal point, the decimal point is spoken as "point" within FAA domain. The ICAO format is spoken as "decimal". So a frequency of 123.95 would be spoken as "one two three point niner five".

5. The number 9 is always spoken as "niner".

When speaking altitudes and flight levels use the following:

1. Up to but not including 18,000 feet MSL (Mean Sea Level) state the separate digits of the thousands plus the hundreds if appropriate. To express for example 12,500 feet one would say "One Two Thousand Five Hundred". *"Twelve Thousand Five Hundred" is not the proper format but would be understood*.

2. At and above 18,000 feet MSL state the words "flight level" followed by the separate digits of the flight level. To express FL 190 one would say "Flight Level One Niner Zero".

When speaking directions:

1. The three digits of bearing, course, heading, or wind direction should always be magnetic. To express a heading of 005 say it as "zero zero five". To express a wind direction of 220 say "wind two two zero".
2. The word "true" must be added when it applies.

When speaking speeds use the following:

1. The separate digits of the speed followed by the word "knots". *Except, controllers may omit the word "knots" when using speed adjustment procedures; ex., "reduce/increase speed to two five zero".* To express a speed of 250 one would say "two five zero knots" except as noted.
2. If stating Mach speeds the separate digits of the Mach number preceded by saying "Mach".

When speaking times:

1. Use Coordinated Universal Time (UTC) for all operations.
2. The word "local" or the time zone equivalent shall be used to denote local when local time is given during radio and telephone communications. To express 0920 UTC one would say "zero niner two zero" but if one expresses the same in local time it is said as follows "zero one two zero Pacific" or "zero one two zero local" or "one twenty AM".
3. *The term "Zulu" may be used to denote UTC*.

Letters are spoken phonetically as follows to ensure there readability:

A = Alpha
B = Bravo
C = Charlie
D = Delta
E = Echo
F = Foxtrot
G = Golf
H = Hotel
I = India
J = Juliet
K = Kilo
L = Lima
M = Mike
N = November
O = October
P = Papa (as in your father)
Q = Quebec
R = Romeo
S = Sierra
T = Tango
U = Uniform
V = Victor
W = Whiskey (the good stuff <grin>)
X = X-Ray
Y = Yankee
Z = Zulu

Here is an example for the use of letters:

Proceed direct to Seattle, Kilo Sierra Echo Alpha (proceed direct to Seattle International or KSEA which is the ICAO identifier for the airport).

Aircraft call signs:

Once the full aircraft ID has been given between a pilot and controller the communications can continue with an abbreviated aircraft ID. For example, N5018R, once established could be abbreviated as 18R. If any aircraft call signs are similar then the full call sign should be used. We will use the full aircraft ID throughout this section. Ever wonder why the U.S. Presidents aircraft has the call sign Air Force One? Interesting story, research it <grin>!

These are but a few of the basics. They will get you started on your way to building your communications skills while participating in online ATC activities. One of the best ways to learn proper phraseology is to log into TeamSpeak during a “live” ATC activity and just listen to the chatter during the activity. You’ll pick up on how the other experienced simulator pilots do it. Never forget no one ever does it perfect and everyone starts at the beginning. So once you have a few of the basics get in on some “live” action that will help you sharpen your own skills. Practice gets you closer to perfect.

EXECUTION OF INSTRUCTIONS

When a controller issues instructions to pilots there is a standard by which the pilot executes those instructions.

1. Any ***normal instruction*** to climb, descend, or turn should be executed by the pilot *without delay*. Completing instructions on a timely basis allows controllers to make judgments about where the aircraft will end up at the completion of such instruction. Unnecessary delays can cause the controller to have to issue follow up instructions to provide the required maneuver or guidance or can disrupt aircraft flow and sequencing. It can also prevent a smooth successful landing.

2. Any instruction that includes the term ***expedite*** should be completed by the pilot with emphasis. In other words if the controller were to say “***expedite*** your descent to 3000 feet” then the pilot should execute as in number 1 above (without delay) and go beyond a normal rate of descent. You may not always get to know why (and yes it could be that the

controller has screwed up and not you <grin>) but regardless, try to accommodate the controller as they are probably trying to keep things in order.

3. Any instruction that includes the term ***immediately*** is a sure sign your in trouble! The pilot should execute the instruction without delay and with extreme emphasis. In other words if the controller were to say instead "descend ***immediately*** to 3000 feet" the pilot needs to push the stick forward hard and descend at a maximum descent rate (far beyond comfortable) to avoid whatever the controller "sees". This is not the time to ask questions, just do it, and ask questions later! You really know you're in deep karma when you hear the controller quickly giving the **other aircraft** a similar instruction!

Figure 489 – Oh @$#*!

PILOT/CONTROLLER COMMUNICATIONS SCENARIOS

During the remainder of this chapter I'll try to show communications from the pilot and controller perspectives. I'll demonstrate where and when specific communications are used. I'll separate VFR and IFR communications to allow you to distinguish the difference between the two but realize that during a single flight these communications scenarios can be mixed and used as required depending on the situation. Your goal is to learn to recognize where and when a particular type of communication is required. You'll also need to learn to recognize when specific pilot/controller communications put you in charge, either from the pilot or controller perspective, of the operations being conducted such as an approach for landing.

Now no real pilot ever starts out flying in an IFR environment (at least not any I know <grin>). Pilots always start at the bottom and work their way up the ladder of skills, certifications, and aircraft types. For instance it still surprises me that most online simulator pilots typically do not know how to fly a true VFR scenario. Most online pilots tend to fly IFR flight scenarios only, and even then only a handful know anything other than an ILS approach (they have that one mastered for sure <grin>)?

Most of the online IFR flights are in crystal clear weather but where is the fun in that? Every now and then try flying in an activity where the visibility is set to 1 mile to keep those IFR skills sharp! When the weather is clear, try the VFR scenarios more often than not. Online pilot's need to challenge their skills, both VFR and IFR, I know I do because that *is* the experience.

If an experienced controller were to give five online pilots the same instruction to expect the visual approach entering the traffic pattern downwind for a left base to runway 5 I dare say the controller would see five different landings <grin>. Well maybe that is stretching it a bit but statistically it will be close to the truth, yet that landing in real-life would probably happen only *one* way. Why is this?

Well first, both pilot *and* controller need to understand the actual operations that occur during flight. Up till now that is what most of this manual has been about, operations of aircraft, cockpit instruments, and online tools such as FSHost and TeamSpeak but to come full circle with our skills both pilot *and* controller must learn to use proper communications and relate these to our operations.

In other words, you may now understand how to operate your GPS 500 like the experts and how to use TeamSpeak to talk to controllers but what good does that do if you can't relate what to do when you reach a specific point in time, or a specific operation, or when the controller issues an instruction not expected? There are specific times when the pilot is in control and when the controller is in control, do you understand how to recognize when it is your turn to step up to the plate? If not then this chapter may be a great benefit to you.

I'll describe how these communications are accomplished in an online environment (unlike in the real-world). Again this is accomplished by learning some basic skills then diving head first into live online activities to gain momentum and become the expert your seeking to become (if you have read the manual this far then I can presume you are a serious candidate for pilot or controller of the year <grin>).

So in this section I'll break down communications into discussions surrounding the phraseology depending on if the communications are at a controlled or uncontrolled airport and either VFR or IFR. I'll also try to point out the specific points that pilots need to pay attention to as far as "doing their own thing" and when to follow the controller's instructions.

One last note, there are typically four general scenarios when it comes to communications during flight that look something like this:

1. VFR flight FROM and TO controlled airports.
2. VFR flight FROM and TO uncontrolled airports.
3. IFR flight FROM and TO controlled airports.
4. IFR flight FROM and TO uncontrolled airports.

These scenarios when mixed and matched can make up any flight scenario, for instance, a flight might start as a VFR flight at an uncontrolled airport but end VFR at a controlled airport. A flight may start as a VFR flight at an uncontrolled airport but end as an IFR flight (IFR filed en route) at an uncontrolled airport. A flight may start as an IFR flight at a controlled airport but end as a VFR flight (IFR canceled en route) at an uncontrolled airport. I think you get the idea. By learning the four scenarios given above you'll be armed with the pieces that make up *ANY* flight scenario possible.

You put the pieces together in the middle (where the flight is with the ARTCC). The typical flight flow consists of the following in consecutive order:

1. Clearance Delivery
2. Ground
3. Tower
4. Departure
5. Center (or ARTCC)
6. Other centers as required.
7. Approach
8. Tower
9. Ground

Typically your flight will always start as one of the four scenarios (steps 1-5 of the flight flow) and end as one of the four scenarios (steps 6-9 of the flight flow). So again, you can see if you understand the four basic scenarios you can effectively complete any flight by piecing together what you need to make it work.

VFR COMMUNICATIONS

Let's start with the VFR communications scenario at a controlled airport. What is unique about a VFR flight that starts at a controlled airport compared to an uncontrolled airport? The VFR pilot must get permission from the appropriate controller to move the aircraft on the ground and to depart the airport. The VFR pilot at the controlled airport is under the same ATC control authority that the IFR pilot is subject to while within the airspace controlled by the ATC authority. VFR pilots will be issued clearances and must follow ATC instructions while in the controlled airspace. The major difference is that the departure controller will eventually "release" the VFR pilot when leaving the controlled airspace and the VFR pilot at that time regains control of the flight. In other words after the VFR pilot departs the controlled airspace the pilot can fly at whatever altitude they choose (following VFR flight rules of course) and proceed en route any way they choose including the scenic route <grin>.

ATC will not fuss or gripe about what the VFR pilot does once released on their own ***BUT*** if the VFR pilot will enter any ATC controlled airspace again the pilot must get permission from the appropriate controller (woo to the pilot who enters controlled airspace without permission and an emergency doesn't exist!). The IFR pilot on the other hand will not be released but remains under ATC control even after departing the locally controlled airspace.

In real-life there are many things a VFR pilot must pay attention to even after departing the controlled airspace, such as restricted airspaces, military operation areas (MOAs), air defense identification zones (ADIZ), and many more. A good example is trying to take a Cessna on a sight seeing tour over the White House (not a bright idea MAYNARD!). That will get some really serious attention (lucky for us we can tour the fantastic scenery of Washington from our computer <grin>).

VFR COMMUNICATION SCENARIO FROM A CONTROLLED AIRPORT

Note1: During online ATC activities the pilot *always* makes ***initial*** contact with ATC by contacting the controller labeled ATC1 in TeamSpeak. This simplifies the requirement for the pilot to actually know the proper starting frequency. From that point the first controller will tell the pilot who to contact next.

Pilot: (say airport name) ground this is (say aircraft ID) VFR to (say destination airport) request taxi for departure to the (say general direction of departure) I have information (say ATIS ID).

Example: Hickory ground this is N9COF VFR to Baltimore Washington Intl (KBWI) request taxi for departure to the northeast I have information Foxtrot.

Note1: During online activities always address the controller as ground when departing VFR. Clearance Delivery is only used for IFR departures for pilots to obtain clearances.

Note2: If you do not tell the ground controller the ATIS ID the ground controller will effectively read you the ATIS information at this point. Even though you obtain this information the tower controller will, just before takeoff, still provide the current wind speed and direction.

Controller: (say aircraft ID) roger, taxi to and hold short of runway (say active runway) via taxiway (say taxiway IDs) contact tower on (say tower frequency) when holding short.

Example: N9COF roger, taxi to and hold short of runway 24 via taxiways Bravo1, Bravo, and Alpha, contact tower on 128.15 when holding short.

Note1: The instructions for taxi are optional by the controller. The pilot can request progressive taxi at any time to facilitate reaching the proper runway for takeoff. When a pilot requests progressive taxi the ground controller provides taxi instructions until the pilot reaches the active runway.

Note2: Pilots are required to maintain contact with the ground controller throughout taxi operations to the holding point or until the ground controller advises otherwise.

Note3: If the ground controller advises the pilot to monitor the tower frequency then the pilot is to tune to the tower frequency provided and monitor this frequency until reaching the hold short point. When ground tells the pilot to monitor the tower frequency the tower controller takes charge of your aircraft and remaining taxi operations. This is sometimes done to expedite takeoffs.

Pilot: (say airport name) ground roger, taxi to and hold short of runway (say active runway number) via taxiway (say taxiway IDs) contact tower on (say tower frequency) when holding short, (say aircraft ID).

Example: Hickory ground roger, taxi to and hold short of runway 24 via taxiways Bravo1, Bravo, and Alpha, contact tower on 128.15 when holding short, N9COF.

Pilot: (say airport name) tower (say aircraft ID) holding short at runway (say active runway number) for departure to the (say general direction of departure).

Example: Hickory tower N9COF holding short at runway 24 for departure to the northeast.

Note1: Departing VFR aircraft should always turn on the landing lights day or night for maximum "see and be seen". It is typical for the pilot to turn on the landing lights while at the hold short point just before takeoff.

Controller: (say aircraft ID) roger (say current wind direction and speed), (say initial heading) and climb to (say initial climb altitude) cleared for takeoff runway (say runway number).

Example: N9COF roger, winds 270 @ 5, maintain runway heading and climb to three thousand cleared for takeoff runway 24.

Note1: The tower controller has the option to instruct the pilot to position and hold on the runway before clearing the pilot for takeoff, listen carefully and follow instructions.

Pilot: (say airport name) tower (say aircraft ID) roger, (say initial heading) and climb to (say initial climb altitude), cleared for takeoff runway (say runway number).

Example: Hickory tower N9COF roger maintain runway heading and climb to three thousand, cleared for takeoff runway 24.

Note1: Shortly after takeoff the tower controller will hand off the pilot to departure, usually when the pilot reaches the boundary of the airport traffic area (within approximately 5 miles at or below 3000' AGL of the airport).

Controller: (say aircraft ID) contact (say airport name) departure on (say departure frequency).

Example: N9COF contact Hickory departure on 125.15.

Pilot: (say airport name) tower (say aircraft ID) roger contact departure on (say departure frequency).

Example: Hickory tower N9COF roger contact departure on 125.15.

Pilot: (say airport name) departure (say aircraft ID) with you climbing through (say current altitude) for (say assigned altitude).

Example: Hickory departure N9COF with you climbing through one thousand five hundred for three thousand.

Controller: (say aircraft ID) roger, squawk (say squawk code) and ident.

Example: N5018R roger, squawk 2355 and ident.

Note1: Typically the VFR pilot will be assigned a squawk code just after takeoff to set into the aircraft transponder. Some ATC services have software to allow this to be properly simulated. While using FSHost this feature is only simulated because FSHost does not properly simulate squawk codes. The departure controller assigns a code to the pilot and requests them to ident (ident tells the pilot to push a button on the transponder so the radar blip will highlight the aircraft on the radar scope and help identify the aircraft).

Figure 490 - Transponder in the Beech King Air (displaying the VFR squawk code).

Pilot: (say airport name) departure roger, squawk (say squawk code) and ident, (say aircraft ID).

Example: Hickory departure roger, squawk 2355 and ident, N9COF.

Controller: (say aircraft ID) radar contact, turn heading (say heading) climb and maintain (say assigned altitude).

Example: N9COF radar contact, turn heading 360 climb and maintain five thousand.

Note1: During online ATC activities when the departure controller (or any controller for that matter) tells the pilot "radar contact" the pilot is under the controller's authority and must follow issued instructions until the controller releases the pilot. If flying using an autopilot use only the *heading (HDG) and altitude (ALT) modes* so you can control the aircraft semi-manual. Do not allow any navigational device to control the autopilot while you are receiving vectors from the controller such as when using the navigation mode (NAV).

Controller: (say aircraft ID) (say departure airport) departure you are leaving my airspace, radar services terminated, squawk 1200 and maintain VFR.

Example: N9COF Hickory departure, you are leaving my airspace, radar services terminated, squawk 1200 and maintain VFR.

Note1: When the pilot reaches the boundary for the departure controllers airspace departure will release the pilot from ATC control by stating "…radar services terminated…" indicating the pilot is now on their own to conduct the flight as they choose until once again entering controlled airspace.

Note2: The VFR squawk code is 1200. When ATC radar interrogates an aircraft transponder with a code of 1200 the controller will know that the pilot is flying VFR and that the pilot may or may not be in contact with any particular ATC agency.

This is a "*chopping point"* for the flight. Depending on the en route weather, pilot certifications, and destination airport, the pilot will need to use whatever communications scenario is appropriate for the arrival whether it be at an airport other than the one departed from or returning to the same airport.

VFR COMMUNICATION SCENARIO TO A CONTROLLED AIRPORT

Note1: During online ATC activities the pilot *always* makes ***initial*** contact with ATC by contacting the controller labeled ATC1 in TeamSpeak. This simplifies the requirement for the pilot to actually know the proper starting frequency. From that point the first controller will tell the pilot who to contact next.

In this VFR scenario we presume that the VFR pilot is arriving at an airport with a surrounding controlled airspace from uncontrolled airspace where the pilot is not under any ATC control whatsoever and is requesting permission to enter the controlled airspace (hence this makes this an ***initial*** *contact).*

Pilot: (Say airport name) approach this is (say aircraft ID) with you (say distance from airport) to the (say general direction from airport) at (say current altitude) requesting a (say intentions) at (say airport name).

Example: Baltimore approach this is N9COF with you 30nm to the southwest at 8000 feet requesting a full stop landing at Baltimore Washington Intl.

Note1: During an approach (and even takeoff), it is especially critical to start turns or altitude adjustments as soon as instructed. Delays in turns and altitude adjustments can cause problems for the controller depending on the air traffic present. If the controller ever states **expedite** a descent, climb or turn **the controller means do it with emphasis!** If a controller were to state descend, climb or turn **immediately**, then you're **quickly** approaching a dangerous situation so **the controller means do it NOW and with emphasis!** It is easy to tell you are in deep karma when you hear the controller quickly giving the **other aircraft** a similar instruction!

Controller: (Say aircraft ID) roger, squawk (say squawk code) and ident.

Example: N9COF roger, squawk 3255 and ident.

Pilot: (Say airport name) approach roger squawk (say squawk code) and ident, (say aircraft ID).

Example: Baltimore approach roger squawk 3255 and ident, N9COF.

Controller: (Say aircraft ID) radar contact, altimeter (say current altimeter setting). You can expect the (say type of approach) to runway (say landing runway number), turn heading (say heading) and (say assigned altitude).

Example: N9COF radar contact, altimeter 30.12. You can expect the visual approach to runway 10, turn heading 200 and descend to 5 thousand feet.

Note1: If the pilot wishes to conduct another approach other than that advised by the controller now is the time to ask the controller. Don't wait until later as the controller may refuse the request. The further out you are when you make such a request the better because the controller has more time to sequence you with other aircraft. Acceptable VFR approaches for most online ATC services are listed in chapter 4 under the section "Pilot Intentions". Based on controller skills available (not just the pilot's skills) the request will either be approved or rejected, please cooperate with your controller.

In the real world (and virtual) ATC makes the call for the type of approach (unless the pilot declares an emergency) based on many factors such as weather, aircraft traffic flow, controller experience, workload, etc… and the pilot should cooperate as best possible. If you need practice with specific approaches tell the controller this or contact ATC in advance for help setting up the practice you need.

Pilot: (Say airport name) approach altimeter (say current altimeter setting) and will expect (say type approach) runway (say runway number). Turn heading (say heading) and descend to (say assigned altitude) (say aircraft ID).

Example: Baltimore approach altimeter 30.12 and will expect the visual approach runway 10. Turn heading 200 and descend to 5 thousand, N9COF.

Note1: The controller should always provide the pilot with the current altimeter when first contact is made. Each subsequent controller should, during initial contact advise the pilot of the current altimeter setting.

Note2: At this time the approach controller continues to vector and descend the pilot to the active runway. At the appropriate time during vectors to final the controller may request the pilot to report the airport in sight.

Controller: (Say aircraft ID) (say airport name) approach, continue heading (say heading) the airport is at your (say general direction to the airport) position (say distance from the airport) report the airport in sight.

Example: N9COF Baltimore approach, continue heading 130 the airport is at your 11 o'clock position 10nm report the airport in sight.

Pilot: (Say airport name) approach roger will report the airport in sight, (say aircraft ID).

Example: Baltimore approach roger will report the airport in sight, N9COF.

Pilot: (Say airport name) approach (say aircraft ID) airport in sight.

Example: Baltimore approach N9COF airport in sight.

Controller: (Say aircraft ID) (say airport name) approach roger, you are cleared (say any specific instructions) for the (say type approach) (say runway number) contact tower on (say tower frequency).

Example: N9COF Baltimore approach roger, you are cleared straight in for the visual approach runway 10 contact tower on 119.40.

Note1: In this situation because the controller has stated the key words "…you are cleared…" this means the pilot now assumes control (and responsibility) to conduct the approach as instructed (in this case "straight in"). The controller might have instructed the pilot to enter a left base for runway 10, if so the pilot should understand airport traffic patterns well enough to enter a proper left base to runway 10. The pilot can control the aircraft altitude as required to make a safe landing.

Pilot: (Say airport name) tower (say your aircraft ID) with you on final for runway (say runway number).

Example: Baltimore tower N9COF with you on final for runway 10.

Controller: (Say aircraft ID) (say airport name) tower altimeter (say current altimeter) (say wind direction and speed) cleared to land runway (say runway number).

Example: N9COF Baltimore tower altimeter 30.15 wind 130 @ 8 cleared to land runway 10.

Note1: Do not land if you don't hear the statement "…cleared to land…"! Even if the controller forgets to issue the clearance to land, go around. Until you hear the clearance to land you do not know if the controller has properly checked the runway environment for a safe landing. Hint: You can always ask the tower controller politely if you have clearance to land, that is usually sufficient to get it taken care of.

Note2: The tower controller should always advise the pilot of the current wind direction and speed. The altimeter though not as important as it is for a pilot making an instrument landing might be provided for the VFR pilot (the VFR pilot if making a legal VFR landing should be able to see the ground <grin>). Also advising the pilot of any wind gusts is a big plus (FSHost does simulate wind gusts <grin>). If another aircraft just departed the runway the controller might even advise the pilot of possible wake turbulence but since it isn't simulated I don't believe it will upset anyone's day (though the controller could throw a caution in for simulated purposes <grin>). The tower controller may provide other additional information such as ice on the runway, wind shear cautions, obscuring phenomenon, anything deemed important to the landing pilot. Even a flock of birds would be sufficient cause to alert the pilot!

Pilot: (Say airport name) tower (say aircraft ID) cleared to land runway 10.

Example: Baltimore tower N9COF cleared to land runway 10.

Controller: (Say aircraft ID) (say airport name) tower exit the runway (say left or right) when able contact ground (say frequency).

Example: N9COF Baltimore tower exit the runway right when able contact ground 121.90.

Pilot: (Say airport name) tower (say aircraft ID) with you clear of runway (say runway number) request taxi to parking.

Example: Baltimore ground N9COF with you clear of runway 10 request taxi to parking.

Controller: (Say aircraft ID) (say airport name) ground roger, taxi to (say type parking) via (say taxiways).

Example: N9COF Baltimore ground roger, taxi to general aviation parking via Romeo1, Romeo, Papa, Alpha, Bravo, November, Sierra, Kilo.

Pilot: (Say airport name) ground (say aircraft ID) roger, taxi to (say type parking) via (say taxiways).

Example: Baltimore ground N9COF roger, taxi to general aviation parking via Romeo1, Romeo, Papa, Alpha, Bravo, November, Sierra, Kilo.

VFR COMMUNICATION SCENARIO FROM AN UNCONTROLLED AIRPORT

Departing (or arriving) at an uncontrolled airport is unique. The uncontrolled airport does not have local ATC services (primarily airport surveillance radar) or an active tower. So it becomes the sole responsibility of the pilot to follow established guidelines to ensure the safety of the aircraft and passengers. This is done by making mandatory radio calls "in the blind" to make other pilots aware of their intentions and movements. There are specific points that radio calls should always be made.

These calls actually emulate those "parts" or "steps" involved during controlled departures (or arrivals).

USING THE UNICOM (OR CTAF) FREQUENCY DURING DEPARTURE

Let's take a look at a VFR departure at an uncontrolled airport from the point where the pilot climbs into the aircraft to depart. The first thing that must happen after the engine(s) are started is the pilot must tune the COM radio to the appropriate CTAF frequency listed for the airport. Each online ATC service should provide for such a common frequency on the communications server to allow virtual pilots to simulate making their *blind calls* just like at a real airport. A typical Unicom frequency might be 123.00 as seen below in figure 491. There are other possible frequencies so look for the frequency label or description to identify frequencies designated for such use. Other pilots may also be on this channel reporting movements and positions at other airports during the same session. Listen carefully as there may be one departing or arriving at the same airport you are located. AT times making calls "in the blind" seems like a waste of time but it is not unlike the real-world. Make the calls, listen, and keep your situational awareness sharp.

Figure 491 - A common Unicom frequency.

The pilot makes a call *in the blind* on the Unicom frequency stating their intention to taxi for departure (*just like calling the ground controller at a controlled airport BEFORE moving the aircraft*), the runway that will be used for takeoff (*similar to the tower function*) and the general direction of departure using typical compass points such as N, E, S, or W from the airport (*similar to the departure controller function at a controlled airport*). All these are done so other pilots will understand your intentions and movements. This is a summary of the main points at which pilots should make such reports on the CTAF (or Unicom) frequency during online ATC activities.

1. Before taxi of aircraft from it's parking position.
2. Holding short for departure at the active runway.
3. When taking off from the active runway.
4. When airborne and clear of the active runway.

It never hurts to add to this list if required. If you are at an uncontrolled airport that is extremely busy than be careful of getting aircraft call signs confused. Make sure you can clearly draw a mental "picture" of where any aircraft of concern is located and the intentions of the pilot. If not sure make a call and clarify the situation and never say more than what is needed so as not to cause confusion, stay brief and to the point.

Pilot: (say airport name) Unicom this is (say aircraft ID) ready to taxi to runway (say runway number) to depart VFR to the (say general direction of departure).

Example: Wilkes County Unicom this is N9COF ready to taxi to runway 19 to depart VFR to the southwest.

Note1: After advising ready to taxi leave the parking area to taxi to the active. Hold short at the hold short line for the next call (A) or if the taxiway does not go to the end of the runway but rather to the center where a back taxi operation will be required to reach the end of the runway for takeoff, again hold short at the proper hold short line and skip to call (B).

(A) - **Pilot:** (say airport name) Unicom (say aircraft ID) taking position on runway (say runway number) for departure to the (say general direction of departure).

Example: Wilkes County Unicom N9COF taking position on runway 19 for departure to the southwest.

(B) - **Pilot:** (say airport name) Unicom (say aircraft ID) is back taxiing to runway (say runway number) for departure to the (say general direction of departure).

Example: Wilkes County Unicom N9COF is back taxiing to runway 19 for departure to the southwest.

Note1: Whenever a back taxi operation is conducted at an uncontrolled airport don't dilly dally on the runway. Get to the end and position for takeoff and depart without delay.

Pilot: (say airport name) Unicom (say aircraft ID) taking off from runway (say runway number) departing to the (say general direction of departure).

Example: Wilkes County Unicom N9COF taking off runway 19 departing to the southwest.

Note1: Departing VFR aircraft should always turn on the landing lights day or night for maximum "see and be seen". It is typical for the pilot to turn on the landing lights while at the hold short point just before takeoff.

Pilot: (say airport name) Unicom (say aircraft ID) clear of runway (say runway number) climbing to (say initial climb altitude) departing to the (say general direction of departure).

Example: Wilkes County Unicom N9COF clear of runway 19 climbing to 5500 feet departing to the southwest.

Note1: When you feel you are safely away from the airport no other calls are necessary. This would be the time to change frequencies to make ***initial*** contact (meaning contact with the controller labeled ATC1) to start VFR flight following if you choose. Address the controller as "Center" telling them your call sign, your location (nautical miles from the airport and general direction), your altitude, and your request for VFR flight following (in other words traffic advisories). Online ATC controllers can provide traffic advisories depending on their workload and other factors. Typically unless the pilot is in a congested area VFR flight following will be of little value but it is always good to simulate it now and then. It is always better to be in contact with ATC in a congested area than not!

Note2: From here the pilot maintains a proper VFR altitude for the direction of travel en route. Unless they enter controlled airspace ATC contact is not required. As long as proper VFR rules are followed online ATC controllers will not bother a VFR pilot but it will never hurt for the VFR pilot to call ATC such as when passing overhead a controlled area (such as traversing over the top of an airport control zone). This way you are in contact with an online ATC controller where other traffic may be. The ATC controllers will appreciate this and it will add to the realism.

VFR COMMUNICATION SCENARIO TO AN UNCONTROLLED AIRPORT

Flying into an uncontrolled airport is just as unique as leaving one for many of the same reasons as just discussed. Primarily no ATC tower is available to provide safe sequencing and separation of aircraft arriving (or departing) from the airport. So once again the sole responsibility rests with each pilot to provide proper radio calls that state their intentions and movements. Landing aircraft should always be given precedence over aircraft on the ground. If an aircraft hears a call from an aircraft on short final for landing at an uncontrolled airport then the pilot on the ground awaiting departure should give the airborne aircraft priority to use the runway.

USING THE UNICOM (OR CTAF) FREQUENCY DURING ARRIVAL

The VFR pilot once again must make use of the CTAF frequency available at the uncontrolled airport to make periodic position reports and to state their intentions. When arriving at uncontrolled airports the usual reporting points might be summarized as follows:

1. Initial approach location and altitude (approximately 20 to 30 miles out).
2. When entering the airport traffic pattern (indicate the leg of entry).
3. When on final approach to land.
4. When clear of the active runway.

Pilot: (Say airport name) Unicom (say aircraft ID) approximately (say distance from airport) to the (say general direction from airport) at (say current altitude) planning a (say intentions).

Example: Wilkes County Unicom N9COF approximately 30nm to the east at 5000 feet planning a full stop landing.

Note1: It is not uncommon in the real-world for an airport FBO (Fixed Base Operator), that's the folks that run the airport and provide services, to have a radio to provide weather and traffic advisories on. They would tell the pilot per known wind direction the active runway and advise of any other known aircraft in the vicinity, still it is always the pilot' responsibility to stay on top of the "big picture", where all aircraft are located, their movements, and intentions. If another aircraft is in the area and being received on the radio than it doesn't hurt to coordinate your intentions with theirs, and if two or more aircraft are in the area be careful not to become confused.

Pilot: (Say airport name) Unicom (say aircraft ID) entering the traffic pattern (say traffic pattern entry) to land runway (say runway number).

Example: Wilkes County Unicom N9COF entering the traffic pattern overhead for a left downwind to land runway 1.

Note1: It is ***VERY*** important for all VFR pilots to understand airport traffic patterns. Whether arriving at an uncontrolled or controlled airport, traffic patterns are commonly used by VFR pilots, even IFR pilots making visual landings may receive specific instructions from an online controller for entering an airport traffic pattern. So study and understand airport traffic patterns so you can draw a correct mental "picture" of what is either happening or required.

Note2: In the call above the phrase "…entering the traffic pattern overhead…" means the pilot is entering the airport traffic pattern via the crosswind leg.

Note2: Remember, airport traffic patterns are typically left-handed unless otherwise indicated.

Pilot: (Say airport name) Unicom (say aircraft ID) turning (say traffic pattern segment) for runway (say runway number).

Example: Wilkes County Unicom N9COF turning on final runway 1.

Note1: It is preferred for pilots to announce their position in all segments of the traffic pattern (such as "…N9COF turning left downwind for runway 1." and "…N9COF turning left base for runway 1." and "…N9COF turning on final for runway 1." this way other pilots will know exactly where to be looking for them in the pattern. Remember, airport traffic patterns typically are 1000 feet AGL.

Pilot: (Say airport name) Unicom (say aircraft ID) clear of runway 1 taxiing to parking.

Example: Wilkes County Unicom N9COF clear of runway 1 taxiing to parking.

Note1: It is important to remember that if the pilot filed a VFR flight plan to close the flight plan. In the real world if the VFR pilot forgets to do this the Calvary will come looking for you <grin>. Really, this search typically begins by telephone to see if the pilot arrived safely at the destination airport. If the aircraft or pilot is not located at the destination filed then the proper search and rescue authority is alerted and deployed to search your filed flight route to see if you have crashed.

During an online ATC activity you can close a VFR flight plan either before landing or after parking the aircraft. Call the controller labeled ATC1 in TeamSpeak addressing them as "Flight Service" and request they close your VFR flight plan.

IFR COMMUNICATIONS

There are many different things that can be encountered in communications during IFR flight scenarios but in our discussions here I'll concentrate on the basic scenarios and from these you will need to fly and gain experience handling the many variables that you will face. All flights are like finger prints, never two the same. Even though common routes are used each flight will be unique due to weather, aircraft problems, and so on. So to will the communications required to handle such situations. So the following IFR communications scenarios can only lay the foundation from which you can start with a minimum of confidence and progress from there. The best way to expand your communications skills is by listening to other communications. Still beware of poor communications practices by other pilots and stick with proper terminologies and phraseologies as best possible.

During IFR flight the pilot rarely has 100% responsibility or control of the flight (except of course during emergencies). The air traffic controller carries much of the burden to separate and sequence aircraft from the time the aircraft starts moving for departure until reaching the parking space at the destination. So it is incumbent of the IFR pilot to understand basic communications that might be received from the air traffic controller. Again I'll break the scenarios down for flights FROM and TO controlled airports and FROM and TO uncontrolled airports so you can clearly see the flow of communications and the peculiarities related to each scenario. Mix and match these scenarios as required to complete a flight successfully, even combining them with the already discussed VFR scenarios depending on the situation.

IFR COOMUNICATION SCENARIO FROM A CONTROLLED AIRPORT

Pilot: (say airport name) clearance delivery this is (say aircraft ID) IFR to (say destination airport) clearance on request.

Example: Hickory clearance delivery this is N9COF IFR to Baltimore Washington Intl (KBWI) clearance on request.

Controller: (say aircraft ID) (say airport name) clearance delivery, clearance on request standby.

Example: N9COF Hickory clearance delivery, clearance on request standby.

Note1: There will be a slight pause while the clearance delivery controller looks up and checks your flight plan. When ready s/he will call you back. *Have a paper pad available for making notes!*

Controller: (say aircraft ID) (say airport name) clearance delivery, clearance is available advise when ready to copy.

Example: N9COF Hickory clearance delivery, clearance is available advise when ready to copy.

Pilot: (say airport name) clearance delivery (say aircraft ID) ready to copy.

Example: Hickory clearance delivery N9COF ready to copy.

Note1: Just a hint here, you filed the clearance so you should have it on paper already, so what you do is follow along checking it per what the controller reads to you now but realize that ATC can change ***ANY*** part of the clearance as they require so be ready with that paper pad and pen to write down any changes (normally you'll get it the way you filed it). Also, you will not know the squawk code until this clearance is given so you ***SHOULD*** write it down (so you don't get busy and forget it, be ready! Copy the clearance verbatim because you must read it back like that once the controller has finished reading it to you.

Controller: (say aircraft ID) is cleared to (say destination airport) as filed. On departure fly runway heading climb and maintain (say initial climb altitude). Expect (say assigned cruise altitude) one zero minutes after departure. Departure frequency will be (say departure frequency) squawk (say squawk code) contact ground on (say ground frequency) when ready to taxi.

Example: N9COF is cleared to Baltimore Washington Intl (KBWI) as filed. On departure fly runway heading climb and maintain five thousand. Expect flight level 230 one zero minutes after departure. Departure frequency will be 125.25 squawk 2355 contact ground on 121.90 when ready to taxi.

Note1: This is your initial flight clearance. Realize that unless changes are made en route that this clearance allows you to fly the entire flight to the destination "as filed". This is required just in case there is a communications failure in flight. Say what? You mean that I can fly the entire flight in IFR conditions if my radio fails? Well, YES! You're an IFR pilot, so flying the plane isn't going to be a problem; the problem is understanding how to handle the loss of communications (review chapter 3 "Emergency Procedures – Communications Failure").

Note2: Note that if loss of communications occurs after takeoff that the pilot would maintain 5000 feet MSL until ten minutes ***AFTER*** takeoff. At that time the pilot would be expected to climb to flight level 230 barring any other minimum safe altitudes required as published on en route charts.

Pilot: (say aircraft ID) cleared to (say destination airport) as filed. On departure fly runway heading climb and maintain (say initial climb altitude). Expect (say assigned cruise altitude) one zero minutes after departure. Departure frequency will be (say departure frequency) squawk (say squawk code) contact ground on (say ground frequency) for engine start and taxi.

Example: N9COF cleared to Baltimore Washington Intl (KBWI) as filed. On departure fly runway heading climb and maintain five thousand. Expect flight level 230 one zero minutes after departure. Departure frequency will be 125.25 squawk 2355 contact ground on 121.90 when ready to taxi.

Note1: The pilot ***MUST*** read back the clearance verbatim. The controller is required to correct any portion of the read back that is not correct until the pilot gets it right.

Controller: (say aircraft ID) read back correct have a safe flight.

Example: N9COF read back correct have a safe flight.

Note1: This is the point where you may want to obtain the latest ATIS information ***BEFORE*** contacting the ground controller for engine start and taxi. Remember, if you do not provide the ground controller the latest ATIS ID during your request for taxi then they will not provide the taxi clearance until they provide the current weather information.

So to speed things up be sure to tell them which ATIS information ID you received while listening (during online ATC activities you would read it) such as in the next communication (A). Otherwise skip to the communication in (B).

(A) - **Pilot:** (say airport name) ground (say aircraft ID) ready for taxi to the active runway. I have information (say ATIS ID).

Example: Hickory ground N9COF ready for taxi to the active runway. I have information Zulu.

Controller: (say aircraft ID) roger, taxi to and hold short of runway (say runway number) via taxiway (say taxiway IDs) contact tower on (say tower frequency) when holding short.

Example: N9COF roger, taxi to and hold short of runway 24 via taxiway Bravo1, Bravo, and Alpha, contact tower on 119.50 when holding short.

Note1: The instructions for taxi are optional by the controller. The pilot can request progressive taxi at any time to facilitate reaching the proper runway for takeoff. When a pilot requests progressive taxi the ground controller provides taxi instructions until the pilot reaches the active runway.

Pilot: (say airport name) ground roger, taxi to and hold short of runway (say active runway number) via taxiway (say taxiway IDs) contact tower on (say tower frequency) when holding short, (say aircraft ID).

Example: Hickory ground roger, taxi to and hold short of runway 24 via taxiway Bravo1, Bravo, and Alpha, contact tower on 119.50 when holding short, N9COF.

(B) - **Pilot:** (say airport name) ground (say aircraft ID) ready for taxi to the active runway.

Example: Hickory ground N9COF ready for taxi to the active runway.

Controller: (say aircraft ID) roger, taxi to and hold short of runway (say runway number) via taxiway (say taxiway IDs) contact tower on (say tower frequency) when holding short.

Example: N9COF roger, wind is 255 @ 7 gusting to 12, clouds scattered at 7000 feet, visibility 7 miles, temperature 76° dew point 68°, altimeter 30.12. Taxi to and hold short of runway 24 via taxiway Bravo1, Bravo, and Alpha, contact tower on 119.50 when holding short.

Pilot: (say airport name) ground roger, taxi to and hold short of runway (say active runway number) via taxiway (say taxiway IDs) contact tower on (say tower frequency) when holding short, (say aircraft ID).

Example: Hickory ground roger altimeter 30.12, taxi to and hold short of runway 24 via taxiway Bravo1, Bravo, and Alpha, contact tower on 119.50 when holding short, N9COF.

Note1: The pilot does not need to read back the complete weather. It is common to repeat the altimeter setting as it is a critical setting for safety.

Note2: As the pilot taxis to the runway maintain contact with the ground controller. *Do not* switch to tower other than as instructed. Also, ***DO NOT*** cross ***ANY*** runway without proper clearance either from a ground or tower controller!

Pilot: (say airport name) tower (say aircraft ID) holding short at runway (say active runway number) ready for departure.

Example: Hickory tower N9COF holding short at runway 24 ready for departure.

Controller: (say aircraft ID) roger (say current wind direction, speed and altimeter), maintain runway heading and climb to (say initial climb altitude) cleared for takeoff runway (say active runway number).

Example: N9COF roger, winds 260 @ 5, upon reaching 1000 feet AGL turn right on course.

Note1: The tower controller has the option to instruct the pilot to position and hold on the runway before clearing the pilot for takeoff (such as when waiting for a departing aircraft to clear the runway or for possible wake turbulence to settle down).

Note2: Note that the instructions provided in this call do not change the initial clearance provided by the clearance delivery controller. The instructions "supplement" the clearance. In the initial clearance provided by the clearance delivery controller the pilot is told to maintain runway heading and climb to five thousand feet MSL. The instructions here tell the pilot to maintain runway heading until reaching 1000 feet AGL then to "…turn on course as filed". It did not say to climb TO 1000 feet (which would change the initial clearance). It instructs the pilot to turn on course ***upon*** reaching 1000 feet AGL and ***THEN*** continue the climb to the initial clearance of 5000 feet MSL.

Pilot: (say airport name) tower (say aircraft ID) roger maintain runway heading until reaching (say altitude), then turn right on course as filed.

Example: Hickory tower N9COF roger maintain runway heading until reaching one thousand, then turn right on course as filed.

Note1: Shortly after takeoff the tower controller will hand off the pilot to departure, usually when the pilot reaches the boundary of the airport traffic area (within approximately 5 miles at or below 3000' AGL of the airport).

Controller: (say aircraft ID) contact (say airport name) departure on (say departure frequency).

Example: N9COF contact Hickory departure on 125.25.

Pilot: (say airport name) tower (say aircraft ID) roger contact departure on (say departure frequency).

Example: Hickory tower N9COF roger contact departure on 125.25.

Pilot: (say airport name) departure (say aircraft ID) with you climbing through (say current altitude) for (say assigned altitude).

Example: Hickory departure N9COF with you climbing through two thousand five hundred for five thousand.

Controller: (say aircraft ID) roger, radar contact. Turn to heading (say heading) climb and maintain (say assigned altitude).

Example: N9COF roger, radar contact. Turn to heading 360 climb and maintain ten thousand.

Note1: When the departure controller (or any controller for that matter) tells the pilot "radar contact" during online ATC activities the pilot is under the controller's guidance and must follow issued instructions until the controller releases the pilot by stating “radar services terminated” or if when on the ground, parked, and cleared to shutdown engines at the end of the flight.

Note2: The departure controller does not have to assign a squawk code because clearance delivery has already done that (remember 2355). In real life the pilot would turn on the transponder with the assigned squawk code just before takeoff. The transponder is normally left in standby mode until reaching the runway for takeoff.

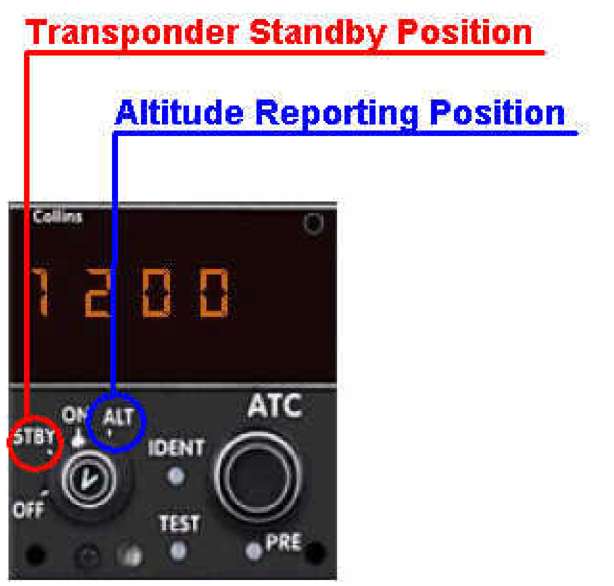


Figure 492 - Transponder standby and altitude reporting switch positions.

The reason is active transponders in the airport area would clutter the radar screen so pilots typically don’t turn them on until takeoff. If the pilot were to forget to turn the transponder on the controller would know because the squawk code wouldn’t show up on the radar display, so, practice switching the transponder on while holding short for takeoff. The same for the landing lights, turn these on while holding short for takeoff.

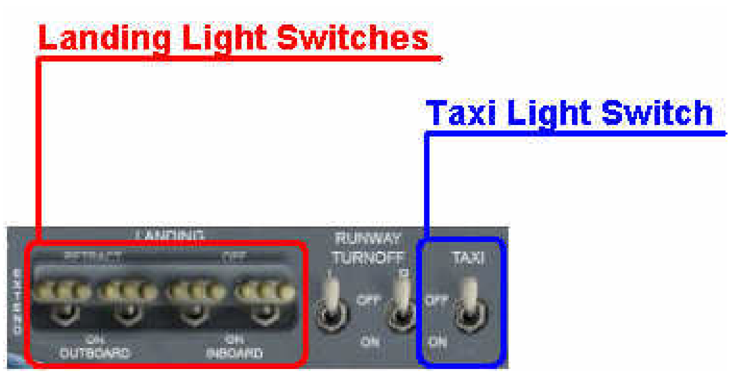


Figure 493 - Landing and taxi light switches.

Note3: When the pilot reaches approximately 30nm out from the airport or is about to reach and climb through FL180 (whichever occurs first) the departure controller will hand off the pilot to the first center controller in the sector where the aircraft is located.

Controller: (say aircraft ID) (say departure airport) departure contact (say center name) center on (say frequency) have a good day.

Example: N9COF Hickory departure contact Atlanta center on 125.15 have a good day.

Note1: From here the pilot will be handed off to subsequent center controllers until reaching there destination.

This is a *chopping point* for the flight. From here the scenario could be mated with any of the other scenarios that would be applicable to the flight.

IFR COMMUNICATION SCENARIO TO A CONTROLLED AIRPORT

Controller: (say aircraft ID) (say center name) center descend and maintain (say assigned altitude).

Example: N9COF Washington center descend and maintain flight level 180.

Note1: The ARTCC will eventually start the aircraft down for the arrival at the destination. This process goes in steps until the center controller hands off the pilot to the airport approach controller.

Pilot: (Say center name) center this is (say your aircraft ID) leaving flight level (say current altitude) for flight level (say assigned altitude).

Example: Washington center this is N9COF leaving flight level 230 for flight level 180.

Controller: (say aircraft ID) (say center name) center descend and maintain (say assigned altitude), altimeter (say current altimeter setting).

Example: N9COF Washington center descend and maintain 10 thousand feet, altimeter 30.12.

Pilot: (Say center name) center this is (say aircraft ID) leaving flight level (say current altitude) for flight level (say assigned altitude).

Example: Washington center this is N9COF leaving flight level 180 for10 thousand feet, altimeter 30.12.

Controller: (Say aircraft ID) contact (say airport name) (say controller name) on (say frequency) have a good day.

Example: N9COF contact Potomac approach control on 119.70 have a good day.

Pilot: (Say center name) center (say your aircraft ID) contacting (say airport name) approach on (say the frequency) have a good day.

Example: Washington center N9COF contacting Potomac approach on 119.70 have a good day.

Pilot: (Say airport name) approach this is (say aircraft ID) with you passing (say current altitude) for (say assigned altitude).

Example: Potomac approach this is N9COF with you passing 15 thousand for 10 thousand.

Controller: (Say aircraft ID) (say controller name) roger, radar contact, altimeter (say current altimeter setting). You can expect the (say type of approach) to runway (say landing runway number), turn heading (say heading) and (say assigned altitude).

Example: N9COF Potomac approach roger, radar contact, altimeter 30.12. You can expect the ILS approach to runway 10, turn heading 200 and descend to 8 thousand feet.

Note1: After initial contact with the approach controller the pilot can request a different approach than what the controller has advised the pilot to expect. Acceptable approaches for most online services are listed in chapter 5 under the section "Pilot Intentions" based on controller skills available (not just the pilot's skills). In the real world (and virtual) ATC makes the call for the type of approach (unless the pilot declares an emergency) based on many factors such as weather, aircraft traffic flow, controller experience, workload, etc… and the pilot should cooperate as best possible. If you need practice with specific approaches tell the controller this or contact your ATC service in advance for help setting up the practice you need.

Pilot: (Say airport name) approach altimeter (say current altimeter setting) and will expect (say type approach) runway (say runway number). Turn heading (say heading) and descend to (say assigned altitude) (say aircraft ID).

Example: Potomac approach altimeter 30.12 and will expect ILS approach runway 10. Turn heading 200 and descend to 8 thousand, N9COF.

Note1: At this time the approach controller continues to vector and descend the pilot to the active runway. The approach controller will issue the following instruction to provide the pilot an approach clearance at the appropriate time.

Controller: (Say aircraft ID) (say airport name) approach, continue heading (say heading) you are cleared for the (say type approach) approach runway (say runway number). Descend and maintain (say assigned altitude) until established on the glide slope.

Example: N9COF Potomac approach, continue heading 130 you are cleared for the ILS approach runway 10. Descend and maintain 2 thousand 5 hundred until established on the glide slope.

Note1: At this time the pilot has been cleared to intercept the ILS localizer (the approach path) and instructed to descend and maintain 2 thousand 5 hundred until established on the glide slope (the electronic descent slope down to the runway) which will allow the pilot to safely conduct the approach and descend to the runway. Under no circumstances is the pilot to descend below the final approach altitude until established on the electronic glide slope.

Note2: The approach controller will not hassle the pilot much at this point as they know you are busy trying to make that perfect landing at the end of a great flight but may require the pilot to report reaching specific points, such as when established on the localizer or reaching a specific fix such as the outer marker beacon. The reason is they to may be busy and by requesting you to report at a given fix will provide them a reminder to make sure they don't forget about you at such a critical time. The approach controller must provide final clearance for the approach and hand you off to the tower in a timely manner so the tower has plenty of time to do their part. If for any reason you reach a point approximately 5nm miles from the runway threshold and the approach controller has not handed you off to the tower provide a quick but gentle reminder such as "Potomac approach N9COF on **short** final ILS runway 10". Trust me that will get there attention if they have not handed you off! The tower will be pressed for time in this case as they must give the pilot the final landing wind direction, speed, altimeter setting and most of all the landing clearance.

Pilot: (Say airport name) approach (say your aircraft ID) maintain heading (say heading) cleared for the (say type approach) approach runway (say runway number). Descend and maintain (say assigned altitude) until established on the glide slope.

Example: Potomac approach N9COF, maintain heading 130 cleared for the ILS approach runway 10. Descend and maintain 2 thousand 5 hundred until established on the glide slope.

Note1: Just like with the initial flight clearance (given by the clearance delivery controller) the pilot ***MUST*** read back the approach clearance verbatim. This is ***NOT*** the time to get confused and make mistakes. The controller is responsible to immediately correct the pilot if the clearance is not read back correctly.

Note2: As stated previously, when the pilot is safely established on the localizer somewhere prior to reaching the outer marker the approach controller will hand off the pilot to tower. It is the pilot's responsibility to know how to conduct the required approach (including the missed approach procedures). Even when the controller is guiding the pilot the pilot ***MUST*** have the approach chart in front of them and previously reviewed for landing. This review should always include the missed approach procedures. If the controller sees something going wrong they can request the pilot to abort the landing if not an emergency. Ultimately the pilot is responsible to properly conduct the approach as published. Be prepared!

Controller: (Say aircraft ID) (say airport name) approach contact (say airport name) tower on (say frequency) have a safe landing.

Example: N9COF Potomac approach contact Baltimore tower on 119.40 have a safe landing.

Pilot: (Say airport name) approach (say aircraft ID) contacting tower on (say frequency) thanks.

Example: Potomac approach N9COF contacting tower on 119.40 thanks.

Pilot: (Say airport name) tower (say aircraft ID) with you on the ILS runway (say runway number).

Example: Baltimore tower N9COF with you on the ILS runway 10.

Controller: (Say aircraft ID) (say airport name) tower roger, report the outer marker.

Example: N9COF Baltimore tower roger, report the outer marker.

Pilot: Report the outer marker (say your aircraft ID).

Example: Report the outer marker, N9COF.

Pilot: (Say airport name) tower (say aircraft ID) over the outer marker.

Example: Baltimore tower N9COF over the outer marker.

Note1: The reason for having the pilot report the outer marker beacon is typically as a reminder for the tower controller to provide your final landing clearance. The tower controller makes a check for an unobstructed runway (the controller will continuously monitor activity on the runway) and provides the pilot with the current wind speed/direction, altimeter setting and current landing visibility before issuing the final landing clearance. Pilots conducting precision instrument approaches are suppose to understand how to properly identify these markers as they are typically part of the approach chart procedures. If you don't understand how to identify a marker then put those thinking caps back on, controllers even though possibly busy, can tell at a glance if you are at the outer marker by looking at it on the radar screen (the markers are normally depicted on the approach course). Just like telling the controller you're on the localizer, they will know if you are fudging this <grin>!

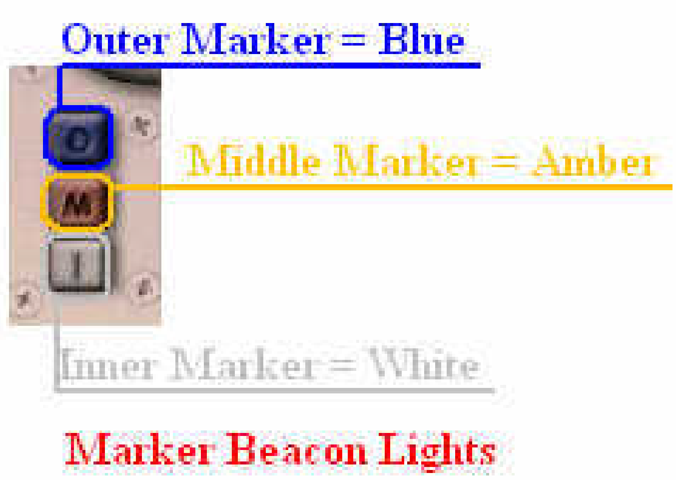


Figure 494 - Cockpit Marker "Fan" Beacon Lights.

Note2: When working with experienced pilots it is not unusual for the controller to hear the marker ID audio in the aircraft cockpit via the pilot's microphone when they are reporting over the beacon if the pilot has turned on the audio as normally done on an approach. The reason the pilot will turn on the marker audio is because they too are busy following the ILS beam, watching other cockpit gauges and so on. So it is easier to just listen for the marker beacon during the approach instead of continuously checking the marker beacon light indicators which by-the-way could be missed as the marker beacon signal only lasts for a short period. The signal from a beacon is a highly focused beam, sort of like an ice cream cone (little end at the ground with the ever increasing wider end as you gain altitude) that the aircraft, if on the proper approach path flies through. If the aircraft is ***NOT*** on the proper approach path there is a chance the pilot will never hear the marker beacon signal because they miss flying through the signals cone.

Controller: (Say aircraft ID) (say airport name) tower roger, wind (say current wind direction and speed), altimeter (say current altimeter) cleared to land runway (say runway number).

Example: N9COF Baltimore tower roger, wind 090 @ 4, altimeter 30.12, cleared to land runway 10.

Pilot: (Say airport name) tower roger, altimeter (say current altimeter) cleared to land runway (say runway number) (say your aircraft ID).

Example: Baltimore tower roger, altimeter 30.12, cleared to land runway 10 N9COF.

Note1: If the pilot does ***NOT*** receive final clearance for landing from the tower controller the pilot ***MUST*** execute a missed approach. Pilots are not allowed to touchdown on the runway until provided final clearance unless an emergency exists. ***DO NOT*** land unless given a proper clearance!

Note2: When the pilot touches down the tower controller will advise which direction the pilot should exit the runway, either left or right. The pilot must stop the aircraft just ***beyond*** the hold short line off the runway (*just the opposite of holding short for takeoff*) until the ground controller can be contacted if not previously cleared. The pilot ***MUST*** receive clearance to taxi to the ramp and remain in contact with the ground controller until parked and engines are shutdown.

MISSED APPROACH AT A CONTROLLED AIRPORT

Remember! Execute first, and then declare!

Pilot: (say airport name) tower (say aircraft ID) missed approach (say intentions).

Example: Baltimore tower N9COF missed approach request vectors to try again.

or…

Example: Baltimore tower N9COF missed approach request clearance to alternate.

The tower controller will provide the pilot the required vectors or clearance as requested.

IFR COMMUNICATION SCENARIO FROM AN UNCONTROLLED AIRPORT

To properly simulate radio communications FROM and TO an uncontrolled airport it is up to each simulator pilot to conduct proper radio transmissions at these airports. Hopefully online ATC services have provided a UNICOM (or CTAF) frequency for pilots to simulate such communications. The pilot may or may not get a response but this is not unlike real-life because many uncontrolled airports have a smaller amount of traffic, especially during inclement weather. Use whatever frequency is provided for the Unicom frequency, a typical frequency is 122.80. There are others, the online service will decide the common frequency used.

While operating aircraft at uncontrolled airports there are certain times or locations where pilots are required to make specific radio calls. These are required to ensure safety of all aircraft and persons. These discussed here are similar to real-life but made to suit virtual operations.

Reporting points are as follows:

1 – Before taxi of aircraft from it's parking position.
2 – Holding short for departure on the active runway.
3 – When taking off from the active runway.
4 – When airborne and clear of the active runway.

IFR pilot's departing an uncontrolled airport must contact ATC to obtain a takeoff clearance either via a telephone or radio call. Some airports have remote radio transceivers to facilitate contact with an ATC facility. Unlike receiving an IFR clearance at a controlled airport ATC will issue the IFR clearance for a pilot at an uncontrolled airport with a time limit attached. Typically the time limit will be 30 minutes. So the pilot normally has the aircraft prepped and ready to go before calling for the clearance that way once it is received they can jump into the aircraft and get going.

Pilot: (say airport name) Unicom this is (say aircraft type and ID) ready to taxi to runway (say runway number) to depart IFR to the (say general direction of departure).

Example: Wilkes County Unicom this is Cessna N9COF ready to taxi to runway 19 to depart IFR to the southwest.

Note1: After advising ready to taxi leave the parking area to taxi to the active. Hold short at the hold short line for the next call (A) or if the taxiway does not go to the end of the runway but rather to the center where a back taxi operation will be required to reach the end of the runway for takeoff, again hold short at the proper hold short line and skip to call (B).

(A) - **Pilot:** (say airport name) Unicom (say aircraft type and ID) taking position on runway (say runway number) for departure to the (say general direction of departure).

Example: Wilkes County Unicom Cessna N9COF taking position on runway 19 for departure to the southwest.

(B) - **Pilot:** (say airport name) Unicom (say aircraft Type and ID) is back taxiing to runway (say runway number) for departure to the (say general direction of departure).

Example: Wilkes County Unicom Cessna N9COF is back taxiing to runway 19 for departure to the southwest.

Note1: Whenever a back taxi operation is conducted at an uncontrolled airport don't dilly dally on the runway. Get to the end and position for takeoff and depart without delay.

Pilot: (say airport name) Unicom (say aircraft type and ID) taking off from runway (say runway number) departing to the (say general direction of departure).

Example: Wilkes County Unicom Cessna N9COF taking off runway 19 departing to the southwest.

Note1: Departing aircraft should always turn on the landing lights day or night for maximum "see and be seen". It is typical for the pilot to turn on the landing lights while at the hold short point just before takeoff.

Pilot: (say airport name) Unicom (say aircraft type and ID) clear of runway (say runway number) climbing to (say initial climb altitude) departing to the (say general direction of departure).

Example: Wilkes County Unicom Cessna N9COF clear of runway 19 climbing to 5500 feet departing to the southwest.

Note1: When you feel you are safely away from the airport no other calls are necessary. This would be the time to change frequencies to make ***initial*** contact (meaning contact with the controller labeled ATC1) to activate your IFR flight plan. Address this controller as "Center" or call them by the exact center name such as "Atlanta Center" if you know which center covers the airport your departing from telling them your call sign, your location (nautical miles from the airport and general direction), your altitude, and your request to activate your IFR clearance. They will provide a squawk code and have you "ident" to make positive identification of your aircraft. Once your aircraft is identified properly they will activate your clearance. From here the flight continues as it would after being handed off from a departure controller to a center controller from a controlled airport.

IFR COMMUNICATION SCENARIO TO AN UNCONTROLLED AIRPORT

Arriving IFR at an uncontrolled airport tends to be very confusing to many simulator pilots. Probably because they can not distinguish at what points specific things happen. For instance, during the initial approach the controller does just like a controller at a controlled airport, vectoring the pilot to intercept an approach and then providing a final approach clearance (again just like at a controlled airport). Once the final approach clearance is received things are different. Why? Because there is no control tower! So from this point on the IFR pilot, just like the VFR pilot takes on full responsibility to ensure a safe approach and landing are conducted and for the radio calls to make other pilots aware of their movements and intentions. So the approach controller not only clears the pilot to conduct the approach but to ***CHANGE*** (or leave) the current frequency to make the mandatory radio calls on the Unicom frequency at the uncontrolled airport. The pilot then makes similar position reports and advises others of the intentions to land at the airport. Once safely on the ground the pilot calls ATC and closes the flight plan.

Controller: (Say aircraft ID) descend and maintain (say assigned altitude), report passing (say altitude).

Example: N9COF descend and maintain 10 thousand, report passing flight level 180.

Pilot: (Say center name) center this is (say aircraft ID) leaving flight level (say current altitude) for (say assigned altitude) will report reaching (say altitude).

Example: Atlanta center this is N9COF leaving flight level 230 for 10 thousand will report passing flight level 180.

Pilot: (Say center name) center (say aircraft ID) passing (say current altitude) for (say assigned altitude).

Example: Atlanta center N9COF passing flight level 180 for 10 thousand.

Controller: (Say aircraft ID) roger, altimeter (say altimeter setting). Turn heading (say heading) and continue your descent to (say assigned altitude).

Example: N9COF roger, altimeter 30.12. Turn heading 060 and continue your descent to 10 thousand.

Pilot: Altimeter (say altimeter setting) turn to heading (say heading) and continue descent to (say assigned altitude) (say aircraft ID).

Example: Altimeter 30.12 turn to heading 060 and continue descent to 10 thousand N9COF.

Controller: (Say aircraft ID) (say controller name), you can expect the (say type approach) approach to runway (say runway number) at (say airport name), turn heading (say heading) and (say assigned altitude).

Example: N9COF Atlanta center you can expect the ILS approach to runway 01 at Wilkes County, turn heading 350 and descend to 4 thousand 3 hundred feet.

Note1: After being advised which approach to expect by the approach controller the pilot can request a different approach (if available) than what the controller has indicated. Acceptable approach types for most online services are listed in chapter 5 under the section "Pilot Intentions" based on controller workload and skills. In the real world (and virtual) ATC has final say as to the type of approach (if not an emergency) based on many factors (such as weather, controller experience, workload, etc…) and the pilot should cooperate as best possible. If you need practice with specific approaches tell the controller this or contact your ATC service in advance for help setting up the practice you need.

Pilot: (say airport name) approach roger, will expect (say type approach) runway (say runway number), turning to (say heading) and descending to (say assigned altitude) (say aircraft ID).

Example: Atlanta center roger, will expect ILS runway 01, turning to 350 and descending to 4 thousand 3 hundred N9COF.

Controller: (Say aircraft ID) (say airport name) approach, turn (say direction either left or right) and maintain heading (say heading) you are cleared for the (say type approach) approach runway (say runway number). Descend and maintain (say assigned altitude) until established on the glide slope. Report back on this frequency if executing a missed approach cleared to switch to the advisory frequency.

Example: N9COF Atlanta center, turn right and maintain heading 360 you are cleared for the ILS approach runway 01. Descend and maintain 3 thousand 3 hundred until established on the glide slope. Report back on this frequency if executing a missed approach cleared to switch to the advisory frequency.

Note1: Don't forget that ***switching to the CTAF frequency automatically implies "radar services terminated"***. The pilot conducts the approach ***WITHOUT*** the aid of ATC and radar services.

Pilot: (say controller name) center (say aircraft ID) maintain heading (say heading) cleared for the (say type approach) approach runway (say runway number). Descend and maintain (say assigned altitude) until established on the glide slope, will report back on this frequency for a missed approach cleared to switch to the advisory frequency.

Example: Atlanta center, N9COF maintain heading 360 cleared for the ILS approach runway 01. Descend and maintain 3 thousand 3 hundred until established on the glide slope, will report back on this frequency for a missed approach cleared to switch to the advisory frequency.

Note1: The pilot ***must read back the approach clearance verbatim***. This is not the time to get confused and make mistakes. ***The controller is responsible to immediately correct the pilot if the clearance is not read back correctly***.

Note2: At this time the pilot has been ***cleared to complete the assigned approach on their own***. The pilot is completely responsible to conduct the approach as officially published for the uncontrolled airport. The approach controller ***tells the pilot to report back up on the current frequency if going missed approach*** and ***clears the pilot to switch to the airports local advisory (CTAF) frequency*** to make the necessary radio calls for safety.

We now pick up the scenario where the pilot has switched over to the Unicom frequency to make the mandatory radio calls "in the blind" at the uncontrolled destination airport.

To properly simulate scenarios at uncontrolled airports it is up to each simulator pilot to conduct proper radio transmissions at the uncontrolled airport by using a CTAF frequency provided by the ATC service. The pilot may or may not get a response but this is not unlike the real thing.

Reporting points are as follows:

1 – Initial approach location and altitude (location at time of switching frequency).
2 – When established on the final approach (when established on the localizer).
3 – When on short final to land (within 5nm of the airport or crossing the outer marker).
4 – When clear of the active runway.

Pilot: (say airport name) Unicom this is (say aircraft ID) type (say aircraft type) approaching from the (say approach direction such as N, E, S or W) approximately (say distance) out at (say current altitude) descending to (say assigned altitude) landing (say type approach) approach runway (say runway number).

Example: Wilkes County Unicom this is N9COF type Cessna Citation approaching from the south approximately 15nm out at 4 thousand 3 hundred descending to 3 thousand 3 hundred landing ILS approach runway 01.

Pilot: (say airport name) Unicom this is (say aircraft ID) established on the (say type approach) localizer runway (say runway number) for a (say intentions).

Example: Wilkes County Unicom this is N9COF established on the ILS localizer runway 01 for a full stop landing.

Pilot: (say airport name) Unicom this is (say aircraft ID) crossing the outer marker landing (say type approach) runway (say runway number) (say intentions).

Example: Wilkes County Unicom this is N9COF crossing the outer marker landing ILS runway 01 full stop.

Pilot: (say airport name) Unicom this is (say aircraft ID) clear of runway (say runway number).

Example: Wilkes County Unicom this is N9COF clear of runway 01.

Note1: If the pilot **completes the landing** safely s/he is **responsible to contact ATC** via telephone or radio **and close the IFR flight plan**. This is simulated during an ATC activity by calling and addressing the controller that handled your approach as "Flight Service" and requesting they close your IFR flight plan.

MISSED APPROACH AT AN UNCONTROLLED AIRPORT

Remember! Execute first, and then declare!

If the pilot ***can not complete the landing*** due to the weather conditions or another situation ***the pilot is required to execute the published missed approach*** until communication with the approach controller is reestablished and further instructions provided. ***The pilot first declares the missed approach on the CTAF frequency then switches back to the approach controller and declares the missed approach***. After declaring the missed approach the pilot states their intentions to either ***try the approach again or proceed on to the alternate airport as filed***. The controller will once again initiate "radar contact" and reestablish positive control of the flight as required.

Pilot: (say airport name) Unicom this is (say aircraft ID) missed approach (say type approach) runway (say runway number).

Example: Wilkes County Unicom this is N9COF missed approach ILS runway 01.

Pilot: (say airport name) approach (say aircraft ID) missed approach (say airport name) (say intentions).

Example: Atlanta center N9COF missed approach at Wilkes County request vectors to try again.

or…

Example: Atlanta center N9COF missed approach at Wilkes County request clearance to alternate.

PILOT/CONTROLLER ROLES AND RESPONSIBILITIES

CHAPTER 7

PILOT/CONTROLLER ROLES AND RESPONSIBILITIES

This chapter is a review and summary of the roles and responsibilities of both a pilot and a controller. These are taken directly from the FAA AIM. The goal is to set copy these standards and guidelines into the virtual world of "live" ATC activities. Following these as closely as possible will serve to make the ATC service (and pilots using the service) sound/look sharp and dedicated to the fulfillment of the online ATC experience so practice these as best possible and expand your individual knowledge to enjoy online ATC activities (r*eference chapter 5 "Air Traffic Procedures" section 5 "Pilot/Controller Roles and Responsibilities" with the AIM for detailed information).*

AIR TRAFFIC CLEARANCE

Pilots…

1. Acknowledge receipt and understanding of an ATC clearance.
2. Read back any hold short of runway instructions issued by ATC.
3. Request clarification or amendment, as appropriate, any time a clearance is not fully understood or considered unacceptable from a safety standpoint.
4. Promptly complies with air traffic clearances upon receipt except as necessary to cope with an emergency. Advises ATC as soon as possible and obtains an amended clearance, if deviation is necessary.

Note: A clearance to land means that appropriate separation on the landing runway will be ensured. A landing clearance does not relieve the pilot from compliance with any previously issued altitude crossing restriction.

Controllers…

1. Issue appropriate clearances for the operation to be conducted, or being conducted, in accordance with established criteria.
2. Assign altitudes in IFR clearances that are at or above the minimum IFR altitudes in controlled airspace.
3. Ensure acknowledgement by the pilot for issued information, clearances, or instructions.
4. Ensure that read backs by the pilot of altitude, heading, or other items are correct. If incorrect, distorted, or incomplete, makes corrections as appropriate.

INSTRUMENT APPROACH

Pilots…

1. Be aware that the controller issues clearance for approach based only on known traffic.
2. Follow the procedure as shown on the IAP, including all restrictive notations, such as:
    a. Procedure not authorized at night;
    b. Approach not authorized when local area altimeter not available;
    c. Procedure not authorized when control tower not in operation;
    d. Procedure not authorized when glide slope not used;
    e. Straight-in minimums not authorized at night; etc.
    f. Radar required; or
    g. The circling minimums published on the instrument approach chart provide adequate obstruction clearance and pilots should not descend below the circling altitude until the aircraft is in a position to make final descent for landing. Sound judgment and knowledge of the pilot's and the aircraft's capabilities are the criteria for determining the exact maneuver in each instance since airport design and the aircraft position, altitude, and airspeed must all be considered.
3. Upon receipt of an approach clearance while on an unpublished route or being radar vectored:
    a. Compiles with the minimum altitude for IFR; and
    b. Maintains the last assigned altitude until established on a segment of a published route or IAP, at which time published altitudes apply.

Controllers…

1. Issue an approach clearance based on known traffic.
2. Issue an IFR approach clearance only after the aircraft is established on a segment of the published route or IP, or assigns an appropriate altitude for the aircraft to maintain until so established.

MISSED APPROACH

Pilots…

1. Execute a missed approach when one of the following conditions exist:
    a. Arrival at the Missed Approach Point (MAP) or the Decision Height (DH) and visual reference to the runway environment is insufficient to complete the landing.
    b. Determined that a safe landing is not possible.
    c. Instructed to do so by ATC.
2. Advise ATC that a missed approach will be made. Include the reason for the missed approach unless the missed approach is initiated by ATC.
3. Comply with the missed approach instructions for the IAP being executed unless other missed approach instructions are specified by ATC.
4. If executing a missed approach prior to reaching the MAP or DH, flies the instrument procedure to the MAP at an altitude at or above the Minimum Descent Altitude (MDA) or DH before executing a turning maneuver.
5. Radar vectors issued by ATC when informed that a missed approach is being executed supersede the previous missed approach procedure.
6. If making a missed approach from a radar approach executes the missed approach procedure previously given or climbs to the altitude and flies the heading specified by the controller.
7. Following a missed approach, requests clearance for specific action; i.e., another approach, hold for improved conditions, proceed to an alternate airport, etc.

Controllers…

1. Issue an approved alternate missed approach procedure if it is desired that the pilot execute a procedure other than as depicted on the instrument approach chart.
2. May vector a radar identified aircraft executing a missed approach when operationally advantageous to the pilot or the controller.
3. In response to the pilot's stated intentions, issues a clearance to an alternate airport, to a holding fix, or for reentry into the approach sequence, as traffic conditions permit.

RADAR VECTORS

Pilots…

1. Promptly complies with headings and altitudes assigned to you by the controller.
2. Questions any assigned heading or altitude believed to be incorrect.
3. If operating VFR and compliance with any radar vector or altitude would cause a violation of any CFR, advises ATC and obtains a revised clearance or instructions.

Controllers…

1. Vectors aircraft in Class A, Class B, Class C, Class D, and Class E airspace:
    a. For separation.
    b. For noise abatement.
    c. To obtain an operational advantage for the pilot or controller.
2. Vectors aircraft in Class A, Class B, Class C, Class D, Class E, and Class G airspace when requested by the pilot.
3. Vectors IFR aircraft at or above minimum vectoring altitudes.
4. May vector VFR aircraft, not at an ATC assigned altitude, at any altitude. In these cases, terrain separation is the pilot's responsibility.

SPEED ADJUSTMENTS

Pilots…

1. Advise ATC any time cruising airspeed varies plus or minus 5% or 10 knots, whichever is greater, from that given in the flight plan.
2. Complies with speed adjustments from ATC unless:
   a. The minimum or maximum safe airspeed for any particular operation is greater or less than the requested airspeed. In such cases, advises ATC.

      Note: It is the pilot's responsibility and prerogative to refuse speed adjustments considered excessive or contrary to the aircraft's operating specifications.

   b. Operating at or above 10000 feet MSL on an ATC assigned SPEED ADJUSTMENT of more than 250 knots IAS and subsequent clearance is received for descent below 10000 feet MSL. In such cases, pilots are expected to comply with 14 CFR Section 91.117(a).

3. When complying with speed adjustment assignments, maintains an indicated airspeed within plus or minus 10 knots or 0.02 Mach number of the specified speed.

Controllers…

1. Assigns speed adjustments to aircraft when necessary but not as a substitute for good vectoring technique.
2. Adheres to the restrictions published in the FAA Order 7110.65, Air Traffic Control, as to when speed adjustment procedures may be applied.
3. Avoids speed adjustments requiring alternate decreases and increases.
4. Assigns speed adjustments to a specified IAS (Knots)/Mach number or to increase or decrease speed using increments of 10 knots or multiples thereof.
5. Advises pilots to resume normal speed when speed adjustments are no longer required.
6. Gives due consideration to aircraft capabilities to reduce speed while descending.
7. Does not assign speed adjustments to aircraft at or above FL390 without pilot consent.

VISUAL APPROACH

Pilots…

1. If a visual approach is not desired, advises ATC.
2. Complies with controller's instructions for vectors toward the airport of intended landing or to a visual position behind a preceding aircraft.
3. The pilot must, at all times, have either the airport or the preceding aircraft in sight. After being cleared for a visual approach, proceed to the airport in a normal manner or follow the preceding aircraft. Remain clear of clouds while conducting a visual approach.
4. If the pilot accepts a visual approach clearance to visually follow a preceding aircraft, you are required to establish a safe landing interval behind the aircraft you were instructed to follow. You are responsible for wake turbulence separation.
5. Advise ATC immediately if the pilot is unable to continue following the preceding aircraft, cannot remain clear of clouds, or lose sight of the airport.
6. Be aware that radar service is automatically terminated, without being advised by ATC, when the pilot is instructed to change to advisory frequency.
7. Be aware that there may be other traffic in the traffic pattern and the landing sequence may differ from the traffic sequence assigned by approach control or ARTCC.

Controllers…

1. Do not clear an aircraft for a visual approach unless reported weather at the airport is ceiling at or above 1000 feet and visibility is 3 miles or greater. When weather is not available for the destination airport, inform the pilot and do not initiate a visual approach to that airport unless there is reasonable assurance that descent and flight to the airport can be made visually.
2. Issue visual approach clearance when the pilot reports sighting either the airport or a preceding aircraft which is to be followed.

3. Provide separation except when visual separation is being applied by the pilot.
4. Continue flight following and traffic information until the aircraft has landed or has been instructed to change to advisory frequency.
5. Inform the pilot when the preceding aircraft is heavy.
6. When weather is available for the destination airport, do not initiate a vector for a visual approach unless the reported ceiling at the airport is 500 feet or more above the MVA and visibility is 3 miles or more. If vectoring weather minima are not available but weather at the airport is ceiling at or above 1000 feet and visibility of 3 miles or greater, visual approaches may still be conducted.
7. Informs the pilot conducting the visual approach of the aircraft class when pertinent traffic is known to be a heavy aircraft.

INSTRUMENT DEPARTURES

Pilots…

1. Prior to departure considers the type of terrain and other obstructions on or in the vicinity of the departure airport.
2. Determines if obstruction avoidance can be maintained visually or that the departure procedure should be followed.
3. Determines whether a departure procedure and/or DP is available for obstruction avoidance.
4. At airports where IAPs have not been published, hence no published departure procedure, determines what action will be necessary and takes such action that will assure a safe departure.

Controllers…

1. At locations with airport traffic control service, when necessary, specifies direction of takeoff, turn, or initial heading to be flown after takeoff.
2. At locations without airport traffic control service but within Class E surface area when necessary to specify direction of takeoff, turn, or initial heading to be flown, obtains pilot's concurrence that the procedure will allow the pilot to comply with the local traffic patterns, terrain, and obstruction avoidance.
3. Includes established departure procedures as part of the ATC clearance when pilot compliance is necessary to ensure separation.

MINIMUM FUEL ADVISORY

Pilots…

1. Advise ATC of your minimum fuel status when your fuel supply has reached a state where, upon reaching destination, you cannot accept any undue delay.
2. Be aware this is not an emergency situation, but merely an advisory that indicates an emergency situation is possible should any undue delay occur.
3. On initial contact the term "minimum fuel" should be used after stating call sign.

   Example: Salt Lake Approach, United 621, "minimum fuel".

4. Be aware a minimum fuel advisory does not imply a need for traffic priority.
5. If the remaining usable fuel supply suggests the need for traffic priority to ensure a safe landing, you should declare an emergency due to low fuel and report remaining in minutes.

Controllers…

1. When an aircraft declares a state of minimum fuel, relay this information to the facility to whom control jurisdiction is transferred.
2. Be alert for any occurrence which might delay the aircraft.